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STATE OF CALIFORNIA
DEPARTMENT OF NATURAL RESOURCES
WARREN T. HANNUM, *Director*

FORTY-FIRST BIENNIAL REPORT

OF THE

DIVISION OF FISH AND GAME

FOR THE YEARS 1948-1950

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WARREN T. HANNUM
DIRECTOR OF NATURAL RESOURCES

HARVEY E. HASTAIN
PRESIDENT, FISH AND GAME COMMISSION

LEE F. PAYNE
COMMISSIONER

EDWIN L. CARTY
COMMISSIONER

WILLIAM J. SILVA
COMMISSIONER

PAUL DENNY
COMMISSIONER

E. L. MACAULAY
EXECUTIVE OFFICER

LETTER OF TRANSMITTAL

July 1, 1950

To His Excellency, Earl Warren
Governor of the State of California
Sacramento, California

Sir: We, the members of the Fish and Game Commission, respectfully submit the Forty-first Biennial Report, covering the period July 1, 1948, through June 30, 1950.

The report contains a resume of the activities of the Fish and Game Commission; an account by the executive officer; and detailed reports on the functions of the various bureaus by their respective chiefs. There also are included complete fiscal statements and tabulations on fish and game management.

Respectfully submitted,

California Fish and Game Commission
Harvey E. Hastain, President
Lee F. Payne
Paul Denny
Edwin L. Carty
William J. Silva

REPORT OF THE FISH AND GAME COMMISSION

At the start of this biennium, the members of the California Fish and Game Commission were:

Harvey E. Hastain, President	Brawley
William J. Silva	Modesto
Lee F. Payne	Los Angeles
Paul Denny	Etna
Edwin L. Carty	Oxnard

Following the expiration of their terms in office, the Governor reappointed:

Edwin L. Carty, on January 21, 1949
William J. Silva, on February 3, 1950

Mr. Silva was president for the period from January 15, 1949, to January 27, 1950, and was followed by Mr. Hastain on January 27, 1950.

At the close of the biennium, the membership of the commission was as follows:

Harvey E. Hastain, President	Term expires 1951
Lee F. Payne	Term expires 1952
Paul Denny	Term expires 1953
Edwin L. Carty	Term expires 1955
William J. Silva	Term expires 1956

E. L. Macaulay continued as executive officer of the commission during the biennium.

LEGISLATION

The Legislature, during the 1949 session, made several changes in the act granting regulatory powers to the commission (see Chapter 1045), requiring that:

(1) two meetings must be held each year during January; at the first meeting the commission shall receive recommendations as to seasons, bag and possession limits for the taking of all kinds of game and sport fish; at the second meeting, the commission is to determine regulations, and, within 10 days thereafter must make public announcement of orders establishing such regulations for the ensuing seasons on fishing and hunting. These meetings are to be held alternately in San Francisco and Los Angeles;

(2) the commission hold scheduled open hearings in any area in which the taking of female deer has been proposed;

(3) the commission hold scheduled open hearings in any area in which the opening of a game refuge has been proposed;

(4) all orders and regulations of the commission are to be compiled, printed and distributed, with copies to "be mailed to each district attorney, county clerk, and justice of the peace throughout the State."

The act was extended for another two-year period.

Another act required that, in lieu of payment of annual taxes, the commission must reimburse counties, annually, an amount equal to the taxes assessed against such property as purchased at the time the land is acquired and used for public shooting grounds. (Chapter 1046, Stats. 1949.)

In the future, all hunting and fishing licenses shall have attached thereto the number of shipping tags, as permitted by the commission; such tags will permit the licensee to ship by common carrier only limited quantities of fish or game.

The fee for a nonresident hunting license was increased to $25; the fee for a nonresident deer tag to $10; the fee for a noncitizen hunting license to $50; the fee for a nonresident sport fishing license to $10; and the fee for a noncitizen sport fishing license to $25.

The use of pheasant license tags was re-established, with a fee of $1 for the same number of tags as the number of pheasants a hunter might legally possess.

Probably the most outstanding legislation was the act establishing "Cooperative Hunting Areas," which should lead to more friendly relationships between property owner, sportsman, and commission. The owner supplies the land at no fee, the commission releases pheasants and supervises and patrols each area, the sportsman has hunting privileges at a fee not to exceed $2 per day.

Several chapters were added to the State Water Code all relating to pollution and its correction. A State Water Pollution Control Board and nine regional water control boards were created, members were appointed by the Governor, their powers and duties defined, and other state agencies concerned with the beneficial uses of water were instructed as to their parts in the over-all program.

This act provides the means for coordinating the actions of the various state agencies and political subdivisions in the control of water pollution, and for enforcing correction of conditions which are dangerous to public health, recreation and the best interests of the State.

Another valuable and much needed act was that defining the offshore boundaries of the State. (Government Code, Chap. 65, Stats. 1949.)

WILDLIFE CONSERVATION BOARD PROJECTS

By the close of the biennium, the Wildlife Conservation Board had allocated over $8,500,000 to 73 projects. The survey of these projects which follows is taken from "California's Fish and Game Program" (1950), a report prepared by Seth Gordon, consultant to the board.

SUMMARY OF APPROVED PROJECTS

Fish Hatchery and Stocking Projects (18)	$2,833,900
Warmwater and Other Fish Projects (6)	164,500
Flow Maintenance and Stream Improvement Projects (14)	450,000
Screen and Ladder Projects (14)	352,140
State Game Farm Projects (4)	106,000
Other Upland Game Projects (4)	443,150
Waterfowl Management Projects (9)	4,177,376
General Projects (4)	65,000
Total (73 projects)	$8,592,066

FISH HATCHERY AND STOCKING PROJECTS

Name, Location and Sponsor	*Description*
1. *Black Rock Rearing Ponds;* Inyo County, near Independence; Div. of Fish and Game. Project No. 36.	New housing facilities and plant improvements. Operated in conjunction with Mt. Whitney Hatchery. Est. production 400,000 catchable trout.
2. *Cedar Creek Hatchery;* Mendocino Co., near Cummings; Div. of Fish and Game. Project No. 29.	Hdqtrs. for coastal stream clearance and improvement, also fish rescue operations. Incidental production may be 10,000 catchable trout and 750,000 fingerlings.
3. *Crystal Lake Hatchery;* Shasta Co., near Cassel; Div. of Fish and Game. Project No. 22.	New plant, partly completed. Est. production 72,000 lbs., 450,000 catchable, 75,000 fingerlings.
4. *Darrah Springs Hatchery;* Shasta Co., site tributary to N. Fork of Battle Creek; Div. of Fish and Game. Project No. 23.	New hatchery plant. Est. production 120,000 lbs., 1,800,000 catchable. An exceptional site for efficient operation.
5. *Deep Creek Stocking Trails (Little Bear Creek and Mojave Campground);* San Bdo. Co., San Bdo. Natl. Forest; Inland F. & G. Cons. Assn. Project No. 2.	Access trails for fish stocking purposes only.
6. *Experimental Pond Construction;* state-wide; Div. of Fish and Game. Project No. 66.	Establishing experimental ponds for test purposes.
7. *Fillmore Hatchery;* Ventura Co., approx. one mile from Fillmore; Div. of Fish and Game. Project No. 38.	New well and pump to permit plant to operate during drought periods. Est. production 90,000 lbs., 1,400,000 catchable.
8. *Fish Springs Rearing Ponds;* Inyo Co., between Independence and Bigpine on Hwy. 395; Div. of Fish and Game. Project No. 37.	New installation. Est. production 80,000 lbs., 1,000,000 catchable.
9. *Glenn-Colusa Hatchery;* Glenn or Colusa Co.; Item 245 from 1947-48 Budget. Project No. 65.	Project held in abeyance pending further investigation and development at Darrah Springs.
10. *Kern River Hatchery;* Kern Co., six miles north of Kernville; Div. of Fish and Game. Project No. 33.	Expansion of former plant. Est. production 40,000 lbs., 300,000 catchable, 50,000 fingerlings.
11. *Moccasin Creek Hatchery;* Tuolumne Co., near junction of Hwys. 49 and 120; Tuolumne Co. Fish and Game Assn. Project No. 17.	New plant. A suitable site, but involving difficult engineering problems. Est. production 80,000 lbs., 1,000,000 catchable, 150,000 fingerlings.
12. *Mojave Hatchery;* San Bdo. Co., near Victorville; Div. of Fish and Game and Inland Fish and Game Conservation Assn. Project No. 39.	New plant with exceptional growth of trout possible. Est. ultimate production 120,000 lbs., 1,800,000 catchable.
13. *Moorehouse Springs Hatchery;* Tulare Co., near Springville, Div. of Fish and Game. Project No. 64.	New plant. Est. production 20,000 lbs., 120,000 catchable.
14. *Mt. Shasta Hatchery;* Siskiyou Co., near Mt. Shasta City; Div. of Fish and Game. Project No. 21.	Rehabilitation of entire plant. Est. production 50,000 lbs., 800,000 catchable, 2,500,000 fingerlings.
15. *San Gabriel Hatchery;* Los Angeles Co., 2 miles north of Pico; Div. of Fish and Game. Project No. 40. (Formerly listed as *Whittier Hatchery.*)	New installation. Est. production 90,000 lbs., 1,400,000 catchable. Size of development will depend upon progress made at Mojave Hatchery.

FISH HATCHERY AND STOCKING PROJECTS—Continued

Name, Location and Sponsor	*Description*
16. *San Joaquin Hatchery;* Fresno Co., downstream from Friant Dam; Sportsmen's Council of Central Cal. and Div. of Fish and Game. Project No. 19.	New plant; excellent site. Est. production 60,000 lbs., 900,000 catchable, 120,000 fingerlings.
17. *Tahoe Hatchery:* Placer Co., one mile north of Tahoe City; Div. of Fish and Game. Project No. 25.	Consolidation of Tallac with Tahoe Hatchery and expansion of present plant. When completed est. production 75,000 lbs., 800,000 catchable, 200,000 fingerlings.
18. *Tule River Hatchery;* Tulare Co., near Camp Wishon; Sportsmen's Council of Central Cal. and Div. of Fish and Game. Project No. 18.	New installation. Est. production 40,000 lbs., 600,000 catchable.
19. *Willow Creek Hatchery;* Lassen Co., north and east of Susanville; Div. of Fish and Game. Project No. 68.	Proposed new plant. Est. production 70,000 lbs., 1,000,000 catchable, 1,500,000 fingerlings.

WARMWATER AND OTHER FISH PROJECTS

Name, Location and Sponsor	*Description*
1. *Coachella Valley Public Fishing Areas;* Riverside Co., near Cities of Indio, Coachella, Mecca and Thermal; Coachella Valley Wild Game Propagation Club. Project No. 74.	Three or four warmwater fishing ponds or lakes in natural basins or eroded areas. Sites made available without cost to State.
2. *Lindo Lake Public Fishing Area;* San Diego Co., east of Lakeside; Div. of Fish and Game at request of Co. Depts. of Public Works and Recreation. Project No. 77.	Drilling well to restore water to dry lake bed; also deepening lake, approx. 15 acres in area.
3. *Ramer Lake Public Fishing Area;* Imperial Co., near Calipatria, on property already owned by Div. of Fish and Game; Imperial Co. Fish and Game Assn. Project No. 72.	Development of warmwater fishing lake by constr. of proper dike and deepening to provide approx. 275-acre lake on N. side Alamo River.
4. *San Antonio Creek Public Fishing Area;* Santa Barbara Co., in the Camp Cooke Military Reservation; Santa Maria Valley Sportsman's Assn. Project No. 86.	Creation of a warmwater fishing lake by constr. of a dam in San Antonio Creek Canyon. (Originally submitted as a waterfowl project.)
5. *San Diego River Development Program;* San Diego Co.; San Diego Co. Federated Sportsmen. Project No. 57.	Development of warmwater fishing ponds in former sand and gravel pits along river bed.
6. *Shasta River Fish Counting Dam:* Siskiyou Co., near junction of Shasta and Klamath Rivers; Div. of Fish and Game. Project No. 61.	Constr. of counting dam for salmon and steelhead, to replace present poorly located dam six miles upstream; also attendant's cottage.

FLOW MAINTENANCE AND STREAM IMPROVEMENT PROJECTS

Name, Location and Sponsor	*Description*
1. *Crystal Lake Level Maintenance;* Los Angeles Co., Angeles Natl. Forest, Upper San Gabriel Canyon; Messrs. W. P. Bryan and Lupi Saldana and U. S. Forest Service. Project No. 73.	Purchase of pipe to collect water now wasted, to maintain proper lake level and provide more public fishing. Forest Service to install pipe.
2. *Deep Creek Stream Improvement (Holcomb Creek Dam);* San Bdo. Co., San Bdo. Natl. Forest; Inland Fish and Game Conservation Assn. Project No. 2.	Dam for reservoir of approx. six surface acres to furnish a continuous flow of water to Holcomb Creek, now intermittent.
3. *Dry Lake Level Maintenance;* San Bdo. Co., San Bdo. Natl. Forest; U. S. Forest Service and Div. of Fish and Game. Project No. 82.	Sealing lake bottom with bentonite to eliminate seepage losses, and increasing height and providing adequate spillway for existing dam.
4. *El Dorado Flow Maint. Dams;* El Dorado and Alpine Cos., El Dorado Natl. Forest; Mt. Ralston Fish Planting Club. Project No. 1.	Constr. of dams on some 46 high mountain lakes to maintain stream flow and fish life during annual dry periods.
5. *Emigrant Basin Flow Maint. Dam and Stream Imp. Program;* Alpine, Calaveras and Tuolumne Cos., Stanislaus Natl. Forest; U. S. Forest Service. Project No. 16.	Dams on 18 lakes, and on Summit and Airola Creeks and the S. Fork of the Mokelumne to maintain stream flow and fish life during annual dry periods.
6. *Granite Creek Flow Maint. Dams;* Madera Co., Sierra Natl. Forest; Div. of Fish and Game. Project No. 41-1.	Dams on Lillian, Rainbow, Rutherford, McClure and Lower Jackass Lakes to maintain stream flow and fish life during annual dry periods.
7. *Marsh Lake Level Maint.;* Inyo Co.; Div. of Fish and Game. Project No. 41-2.	Dam to restore this heavily fished lake to its original area of four acres.
8. *Mendocino Natl. Forest Stream Impr. and Flow Maint. Program;* Colusa and Glenn Cos.; U. S. Forest Service and Senator Louis G. Sutton. Project No. 12.	Experimental plantings, particularly on Thomes, Grindstone and Big and Little Stony Creeks, to re-establish streamside cover destroyed by severe floods during winter of 1937-38.
9. *Pine Creek Flow Maint. Dam;* Lassen Co., Lassen Natl. Forest; Div. of Fish and Game. Project No. 4.	Dam, complete with fish ladder to permit Eagle Lake trout to migrate to spawning areas.
10. *Sacramento River Weir* (rough fish barrier); Shasta Co., on Sacramento River above Shasta Lake; Div. of Fish and Game. Project No. 67.	Dam to prevent passage of rough fish from Shasta Lake upstream, equipped with fish ladder suitable for trout and holding tank to permit segregation of rough fish.
11. *San Bernardino National Forest Stream Imp.;* San Bdo. and Riverside Cos.; Div. of Fish and Game, U. S. Forest Service and Inland Council of Cons. Clubs. Project No. 81.	General stream improvement and flow maintenance program on 14 separate streams.
12. *San Diego County Flow Maint. Dam Program;* San Diego Co.; San Diego Co. Federated Sportsmen. Project No. 58.	Dams to maintain stream flow and fish life during annual dry periods on 10 streams throughout county, totaling approx. 92 miles.
13. *Sequoia Natl. Forest Flow Maint. Program;* Tulare and Kern Cos.; U. S. Forest Service. Project No. 51.	Dams on 10 streams within forest to maintain stream flow and fish life during annual dry periods. Project requires further detailed study.
14. *Tahoe Natl. Forest Flow Maint. and Imp. Program;* Nevada, Placer and El Dorado Cos.; U. S. Forest Service. Project No. 49.	Dams to control lake levels and maintain stream flow and fish life during annual dry periods. Includes Upper Truckee River improvement.

FISH SCREEN AND LADDER PROJECTS

Name, Location and Sponsor	*Description*
1. *Battle Creek Screen;* Shasta Co. side of Battle Creek; Div. of Fish and Game. Project No. 44-9.	Screening irrigation ditch intake about ¼ mile below Coleman Fed. Hatchery to safeguard young salmon and steelhead on way to ocean.
2. *Bennett and Smith Dam Fish Ladder;* Siskiyou Co., on S. Fork of Salmon River; Div. of Fish and Game. Project No. 44-3.	Replacement of present inadequate, poorly located ladder.
3. *Burnt Ranch Falls Fish Ladder;* Trinity Co., on main Trinity River; Div. of Fish and Game. Project No. 44-2.	Creation of fish ladder by blasting pools out of the bedrocks in the more difficult rapids.
4. *Canyon Creek Fish Ladder;* Trinity Co., four miles upstream from junction of Canyon Creek and Trinity River; Trinity Co. Sportsmen. Project No. 62.	Replacement of unsatisfactory wooden ladder with better located ladder and larger steps.
5. *Central Headquarters for Stream Improvement;* Sacramento Co., at Central Valleys Hatchery, Elk Grove; Div. of Fish and Game. Project No. 42.	Prefabricated building to serve as equipment warehouse and to house machine shop for constr. of minor installations and repairs.
6. *Daguerre Point Fish Ladders;* Yuba Co., at junction of Dry Creek and Yuba River; Div. of Fish and Game. Project No. 3.	Constr. of two fishways at opposite ends of 750′ lg. Daguerre Pt. Dam, which now blocks salmon from about 90% of their spawning grounds.
7. *Deer Creek Falls Fish Ladder;* one mile upstream from Potato Patch Camp Grounds, Tehama Co.; Associated Sportsmen of California. Project No. 9.	Ladder approx. 25′ high to permit salmon to ascend to spawning grounds.
8. *Deer Creek Fish Screens;* Tehama Co., three miles NE. of Vina; Div. of Fish and Game. Project No. 44-5.	Three screens and by-passes on irrigation ditches.
9. *Glenn-Colusa Canal Screens;* Glenn Co., Sacramento River and Stony Creek; Div. of Fish and Game. Project No. 43.	Mechanical screens to prevent heavy annual losses of young salmon. Ditch at max. carries over 2,200 c. f. s. Present rack wholly unsatisfactory.
10. *Mendota Fish Ladder;* Fresno Co., one mile NE. of Mendota; Div. of Fish and Game. Project No. 44-7.	Fish ladder over dam at Mendota Pool on San Joaquin River.
11. *Merced Fish Screen and Ladders;* Merced Co., in vicinity of Snelling, about 15 miles E. of Merced; Div. of Fish and Game. Project No. 44-6.	Four fish ladders and one screen on Merced River.
12. *Salt Slough Fish Ladder;* Merced Co., five miles E. of Los Banos; Div. of Fish and Game. Project No. 44-8.	Fish ladder from San Joaquin River into Miller-Lux Canal to divert fish around dried-up section of main stream channel.
13. *Sawyer's Bar Auxiliary Dam;* Siskiyou Co., on N. Fork of Salmon River; Div. of Fish and Game. Project No. 63.	Present fish ladder at Sawyer's Bar Dam unsatisfactory. Auxiliary dam to raise water level in pool below existing structure to allow fish to ascend.
14. *Sutter-Butte Fishway;* Butte Co., Feather River, 5 miles E. of Gridley; Div. of Fish and Game. Project No. 45.	To replace present inadequate fishway which is responsible for heavy salmon losses.

GAME FARM PROJECTS

Name, Location and Sponsor	*Description*
1. *Brawley Game Farm;* Imperial Co., Div. of Fish and Game, Item 245, 1947-48 Budget. Project No. 519-10.	To expand game propagation facilities and improve housing.
2. *Chico Game Farm:* Butte Co.; Div. of Fish and Game, Item 245, 1947-48 Budget. Project No. 519-7.	To expand game propagation facilities and improve housing.
3. *Marysville Game Farm;* Yuba Co.; Div. of Fish and Game, Item 245, 1947-48 Budget. Project No. 519-8.	To expand game propagation facilities and improve housing.
4. *Porterville Game Farm;* Tulare Co.; Div. of Fish and Game, Item 245, 1947-48 Budget. Project No. 519 9.	To expand game propagation facilities and improve housing.

OTHER UPLAND GAME PROJECTS

Name, Location and Sponsor	*Description*
1. *Coast Counties Quail Habitat Improvement:* Central Coast Cos.; Div. of Fish and Game. Project No. 549.	Provide watering places and other habitat improvements.
2. *Desert Quail Development:* desert region of Southern California; Div. of Fish and Game and Inland Fish and Game Assn. Project No. 503.	Provide watering places and other habitat improvements.
3. *Quail Habitat Development:* all of California S. of U. S. Hwy. 40, with major emphasis S. of the Tehachapi; Div. of Fish and Game. Project No. 554.	Providing watering places and improved habitat for quail and other game in regions with insufficient water and cover to maintain a game supply.
4. *Doyle Winter Range;* SE. corner of Lassen Co.; Div. of Fish and Game. Project No. 515.	Construction of residence, garage and shop, fencing, etc.

WATERFOWL PROJECTS

Name, Location and Sponsor	*Description*
1. *Butte Sink Waterfowl Mgt. Area;* Colusa Co., in Lower Butte Basin, bordered on the E. by Butte Creek and extending westward toward Sacramento River; staff of Board and Div. of Fish and Game. (Alt. to *Upper Butte Creek.* Project No. 507.)	One of seven key waterfowl management projects to provide feeding grounds, resting areas, and public shooting. Approx. 3,578 acres, plus possible 1,000 acres addl. (Orig. Upper Butte project consisted of 5,760 acres located farther north.)
2. *Delta Waterfowl Mgt. Area;* Solano Co., on the eastern side of Grizzly Island, along Suisun Bay; staff of Board and Div. of Fish and Game. Project No. 550.	One of seven key waterfowl management units to provide feeding, resting, and public shooting grounds. Approx. 8,600 acres.
3. *Honey Lake Waterfowl Mgt. Area;* SE. Lassen Co.; Div. of Fish and Game. Project No. 523.	Construction of ponds, canals, control structures, etc.
4. *Imperial Valley Waterfowl Mgt. Area;* Imperial Co., near Salton Sea; Div. of Fish and Game. Project No. 536.	One of seven key waterfowl management units to provide feeding, resting, and public shooting grounds.

WATERFOWL PROJECTS—Continued

Name, Location and Sponsor	*Description*
5. *Lower Butte Creek Waterfowl Mgt. Area;* Butte Co., N. of Marysville Buttes; staff of Board and Div. of Fish and Game. Project No. 548.	One of seven key waterfowl management units. Expansion of present Gray Lodge Refuge. 4,020 acres in area originally proposed.
6. *Lower San Joaquin Waterfowl Mgt. Area;* Merced Co.; staff of Board and Div. of Fish and Game. Project No. 506.	One of seven key waterfowl management units. Expansion of Present Los Banos Refuge. 6,678 acres to be purchased on San Luis Island (alternate to original area of 5,660 acres).
7. *Madeline Plains Waterfowl Mgt. Area;* Lassen Co.; Div. of Fish and Game. Project No. 522.	Equipment, construction of ponds, roads, etc.
8. *Madera Waterfowl Mgt. Area;* Madera Co., in the San Joaquin River Valley; staff of Board and Div. of Fish and Game. Project No. 532.	One of seven key waterfowl management units to provide feeding, resting, and public shooting grounds. Approx. 5,120 acres.
9. *Upper San Joaquin Waterfowl Mgt. Area;* Kern Co.; Staff of Board and Div. of Fish and Game. Project No. 551.	One of seven key waterfowl management units. Tupman Elk Refuge plus 4,060 acres of adjacent lands.

GENERAL PROJECTS

Name, Location and Sponsor	*Description*
1. *Airplane Hangar;* Sacramento Co., at the Sacramento Municipal Airport; Div. of Fish and Game. Project No. 1008.	Constr. of 60′ x 80′ hangar for two Div. of Fish and Game planes, complete with workshop and storage space.
2. *Central Laboratory and Statistical Building;* Alameda Co., Berkeley; Div. of Fish and Game. Project No. 1001.	Building to house statistical department, now unsatisfactorily located on Terminal Island, and to furnish laboratory for all research workers of the Div. of Fish and Game.
3. *Delta Fish and Game Operations Base;* Contra Costa Co., near S. end of Antioch Bridge, four miles E. of Antioch; Div. of Fish and Game. Project No. 1010.	Construction of centrally located field operations base for Bureaus of Marine Fisheries, Fish Conservation, and Patrol, including 40′ x 60′ warehouse and net workshop, 40′ x 40′ net rack and berthing facilities.
4. *S. Humboldt Bay Public Recreational Area;* Humboldt Co., approx. 5 miles SW. of Eureka; Div. of Fish and Game and Northern Humboldt Fish and Game Club. Project No. 1006.	Acquisition of approx. 760 to 900 acres of land along the bay for recreational purposes, particularly surf fishing and waterfowl shooting.

REPORT OF THE EXECUTIVE OFFICER

The Fish and Game Commission requested the Department of Finance, through its administrative analyst staff, to make an administrative survey of the Division of Fish and Game, with a view toward reorganizing the division. Following submission of this report of survey the executive officer held many conferences with representatives of the U. S. Forest Service, the U. S. Fish and Wildlife Service, and the State Division of Forestry, all of whose activities are similar to our own, to determine the best plan for an administrative reorganization of the Division of Fish and Game.

The recommended plan of the executive officer and the bureau chiefs, which was submitted to and accepted by the commission on June 27, 1950, at Shasta Springs, California, is quoted herewith:

RECOMMENDED PLAN FOR ADMINISTRATIVE REORGANIZATION OF THE DIVISION OF FISH AND GAME

The last reorganization of the Fish and Game Division activities took place in 1926, and the following comments published in the quarterly magazine for January of that year are interesting:

COMMISSION'S WORK REORGANIZED

The work of conserving the fish and game resources of California is a great undertaking and the numerous employees of the commission must work together if real accomplishments are to be attained. Just as the efficient administration of any large corporation is dependent upon a selected group of department heads upon whom responsibility is fixed, so in the work of the Fish and Game Commission similar departmental organization has become necessary. In fulfillment of the promise to give conservation work a thoroughly businesslike administration, the work of the commission is to be accomplished through certain departments and bureaus. The main departments will be Administration, Patrol, Fishculture, Ladders and Screens, and Commercial Fisheries. Less important branches of the work will be designated as the Bureaus of Accounts, Education and Research, Publicity, and Game Farms.

At the time of this 1926 reorganization the division had approximately 200 employees with an annual budget slightly in excess of $800,000. Approximately one-quarter million hunting licenses were sold in that year and slightly less than one-quarter million angling licenses. At the present time the division has over 700 employees with an annual budget of $5,500,000, not including Wildlife Conservation Board appropriations. The sale of hunting licenses has increased to approximately one-half million, while angling license sales have almost reached the million mark. It is apparent that the system which was satisfactory 20-odd years ago cannot handle the tremendous increase in the work load today.

The executive officer and the bureau chiefs have held many conferences and have reached the conclusion, after discussions with representatives from the U. S. Forest Service, the State Division of Forestry, and the U. S. Fish and Wildlife Service, whose activities more or less correspond to our own, that a line and staff organizational setup, with regional offices, will best suit our requirements.

I. FUNCTIONS OF THE DIVISION OF FISH AND GAME

The work of the Division of Fish and Game falls into several major functions:

A. Assistance in formulation and application of fish and game policies.
B. Fish and game management and habitat control.
C. Law enforcement.
D. Propagation of fish and game.
E. Fish and game research.
F. Conservation education and public information.
G. License sales.
H. Fiscal, budgetary and personnel controls.

II. DEFICIENCIES IN THE PRESENT ORGANIZATION

Several deficiencies in the present organization of the Division of Fish and Game hinder the efficient accomplishment of the above functions. These can be listed as:

A. An important shortcoming in the present organization is the fact that the chiefs and intermediate staffs of the present bureaus have a dual capacity; policy making and interpretation, *and* the problem of actually administering this policy in the field. Most modern organizations of the size and complexity of the Division of Fish and Game separate the functions of policy leadership and interpretation under one category which is generally designated as staff, and the administrative responsibilities generally known as line authority. It is felt that an over-all organization within the division of the line and staff type would go a long way toward overcoming this deficiency in our present organization.

B. A second major deficiency in the present organization is the lack of coordination among the field personnel of the present bureaus. In general, coordination among the functions of the present bureaus is fairly satisfactory at the bureau chief level where constant contacts are made among the various chiefs in the San Francisco office. At the field level, however, there is in various areas of the State a lack of understanding of the problems that arise from the functions of the present bureaus. In many cases staff and operating members of one bureau are fully aware of commission policies and commission aims with respect to handling certain fish and game management matters, whereas the personnel of another bureau lack such understanding, and the resulting confusion, as far as statements to the public are concerned, puts the whole division in a poor position. This is perhaps the greatest deficiency in our present organization. Establishment of regional offices in which middle level personnel could have daily contact and regional direction would aid materially in such coordination and should be considered as a first step in any reorganization plan.

C. The public is unable to obtain information or a clear statement of commission policy and activities on the local level. Established commission policy and activities should be readily available to the public locally.

D. Many of the administrative difficulties of the Division of Fish and Game result from the organizational set-up in Sacramento, both between the division and the Department of Natural Resources, and between the division and the other agencies of State Government through the department. Fiscal control and the processing of personnel and other documents are unduly complicated and slow. Reorganization of the Division of Fish and Game alone will not correct these shortcomings. It is, however, suggested that within the division itself many administrative procedures be standardized and placed on a regional basis.

III. PROPOSALS FOR AN IMPROVED ORGANIZATION

It is proposed that the Division of Fish and Game be modified into a line and staff type of organization together with the establishment of regional offices.

A. Regions

It is suggested that the State be divided into 11 administrative regions with headquarters as follows:

I. Eureka
II. Redding
III. Chico
IV. Sacramento
V. San Francisco
VI. Modesto
VII. Monterey
VIII. Fresno
IX. Bishop
X. Los Angeles
XI. San Diego

The basis for determining these regions is a dual one—taking care of the functions of the division as listed in Section I above, and of being of service to the public. The plan takes into consideration natural fish and game habitat zones, routes of travel and conveniently spaced population centers that may serve as headquarters for regional administrative offices. These offices must of necessity be of such size and nature that they will serve adequately all executive, staff and administrative personnel necessary to the proper functioning of each region.

The division already maintains at least a small installation at each of the regional headquarters proposed except for Modesto. Additional quarters would be needed at some but not all of these points.

The proposed regions would not be so large as to make proper administration difficult. The regional staff would be able to visit all installations frequently and maintain close touch with all personnel. Adequate administration would be possible along the entire coast, justified by the importance of the ocean fisheries.

Aside from the division's administrative needs, one of the principal functions of the regional offices will be to serve as centers of information for the public, and for that reason alone they should be situated strategically and not too few in number. The U. S. Forest Service is responsible for the administration of about one-fourth the land area of California, and has an organization similar to the one proposed herein. This agency has found it necessary to divide its work among 18 forest supervisors. The State contains 11 highway districts and several other state agencies have districted the State on about the same basis for administrative purposes.

Creation of any lesser number of regions would result in such large administrative units that it would be necessary to subdivide the regions and establish branch offices with subordinate staffs. This would be cumbersome and expensive, and would add one more link in the administrative chain.

B. Suggested Organization

The over-all pattern suggested for the reorganization of the division is a line and staff organization wherein the various functions listed under Section I are administered as a result of staff advice and leadership through the various regions listed in Section III A.

This organization is roughly the same type as that used in the U. S. Forest Service, the U. S. Fish and Wildlife Service, the Michigan Department of Conservation, the Pennsylvania Department of Game, and Washington Department of Game. It has been adapted from these various plans to fit California conditions.

The California plan as herein presented involves a state administrative set-up which has as its head a Chief of the Division of Fish and Game, aided by assistant chiefs who will aid him in matters of policy as it affects various subheadings of his over-all responsibilities. These assistant chiefs of the Division of Fish and Game are:

Assistant Chief, Game
Assistant Chief, Wildlife Protection
Assistant Chief, Inland Fisheries
Assistant Chief in charge of administrative matters including finance and fiscal matters, budgets and accounts, personnel matters, license distribution
Assistant Chief, Marine Fisheries

Also responsible to the Chief of the Division of Fish and Game would be a Supervisor of Conservation Education who would act as a staff advisor.

Responsible to the Chief of the Division of Fish and Game would be the 11 regional managers who would be in charge of the execution of all functions in their regions. Each would be organized according to the rough pattern of the over-all state organization. In other words, attached to each regional manager would be staff assistants for game, inland fish, marine fish, law enforcement, and fiscal and personnel matters *as needed in each region*. In some regions more than one function might be handled by a single staff assistant.

Such functional employees as wardens, trappers, game farm personnel, fish hatchery personnel, upland game management crews, stream improvement crews, etc., as would be necessary to fulfill the action or line functions undertaken by the division in each region would be responsible to the regional manager of the respective region. The staff of the regional manager would aid him in matters of policy and leadership in carrying out the several functions within his region.

Research direction, being state-wide in its nature, would be carried on as a function of the state level staff. Assistance in carrying on research would be given by the regions as necessary.

C. Regional Managers

The whole success of the suggested plan hinges upon the caliber of the men selected as regional managers. The major change brought about by the adoption of the line and staff organization would be the decentralization of the work of the division and the delegation of responsibility to the regional manager for the work of the division in each area. The *selection* of these regional managers and the *size* of the areas they are called upon to administer thus become the major factors that will determine the success or failure of the new organization.

The following are the main principles upon which the regional managers should be selected:

1. The best opportunity for finding suitable men is among the 700 employees of Fish and Game.
2. The examination for these positions should be open on a competitive basis to all men with a reasonable amount of experience, maturity and previous responsibility, including men from outside the division who can qualify.
3. Salaries should be above those now paid to any of the men to be under the regional manager's supervision.
4. The qualifications and knowledge required should give a fair opportunity for men from all of the fields of law enforcement, management, research and administration.

D. Statements of Commission Policies

No decentralized organization can function properly without established policies for guidance. Without them the several regions might be administered quite differently, resulting in uneven service to the public and inequities to the personnel, as well as shortcomings in wild life management.

There is at present a lack of written commission policies on various phases of fish and game management, accompanied by a poor distribution to men in the field of such policies that do exist. Such lack of written policies has resulted in employees making individual interpretations on fish and game matters that are quite often at a variance with sound procedures both as far as the wild life itself is concerned and as far as the public is concerned. Such firm policies should be adopted by the commission dealing with each of the major species of fish and game as well as their major management problems. Such policies should not be considered as fixed and unchanging, but should be regarded as living policies subject to continual revision by the commission upon recommendation of the staff and the public.

With the type of organization such as outlined herein, dissemination of policies to all personnel would be a simple matter. These policies would be made known to the people of the entire State by the regional personnel uniformly and without delay or distortion.

E. The Need for an In-Service Training Program

In order to implement the organizational plan presented herein and to insure its success, it is recommended that the division institute an in-service training program. Almost as important as the necessity for reorganization of the division is the need for various personnel of the division to be informed on all fish and game matters since virtually every employee of the division is called upon at some time or another to explain the work of the division as a whole or he may be called upon to explain the work of other members of the division, work with which he has no particular contact in the ordinary course of his duties.

A well-planned, permanent in-service training program could do as much to put the Division of Fish and Game and the Fish and Game Commission in a better position to perform their services as would any reorganization that might be devised. It is suggested, therefore, that some plan such as the following program be adopted. Five in-service training officer positions should be set up as follows (one of these positions is already in the budget):

1. Law enforcement instruction.
2. Administrative, fiscal and personnel matters.
3. Game management.
4. Inland fisheries management.
5. Marine fisheries management.

These in-service training officers should be attached to the assistant chiefs in charge of each of these functions and should in addition act together as a body, as

an in-service training faculty to indoctrinate thoroughly all personnel of the division, and to conduct periodic schools for all permanent employees on a planned, rotating basis. It should be the responsibility of the in-service training staff to prepare manuals of procedure and policy.

Corollary to the general need for an in-service program as outlined above is the need for periodic inspections of field functions by state level staff as well as the need for periodic, planned regional meetings of regional staffs at which state level staff should be in attendance and take part in the program.

As soon as a determination is made by the commission of the number of regional districts which would be most suitable, I recommend the proposed plan be submitted to the Senate and Assembly Interim Committees, the Director of Finance, the Personnel Board, the Legislative Auditor, sportsmen groups, and the press for their study, with a request that their suggestions or comments be returned at an early date.

(Signed)

E. L. Macaulay
Executive Officer

PERSONNEL CHANGES

DEATHS

Arthur L. Stager, Fish and Game Patrol Captain	Oct. 28, 1948
August Bade, Chief, Bureau Game Farms (retired)	Feb. 11, 1949
S. H. Dado, Assistant Chief, Bureau Marine Fisheries (retired)	Mar. 12, 1949
Carl J. Walters, Fish and Game Warden	June 9, 1949
Eugene Platt, Game Farm Superintendent	July 11, 1949
Ethel W. Murphy, Intermediate Stenographer-Clerk	July 25, 1949
Abe Woodard, Fish Hatchery Man (retired)	Sept. 15, 1949
C. S. Bauder, Assistant Chief, Patrol (retired)	Sept. 27, 1949
Earl Hiscox, Fish and Game Warden	Nov. 3, 1949
Gen. H. H. Arnold, Former Commissioner	Jan. 15, 1950
Fred Hecker, Fish and Game Patrol Captain	Jan. 20, 1950
Henry Ocker, Fish and Game Warden	Jan. 26, 1950
Frank Schulmeyer, Game Conservation Aid (retired)	Jan. 30, 1950
Rudy Gerhardt, Fish and Game Warden	Mar. 17, 1950

RETIREMENTS

Brian Curtis, Supervising Fisheries Biologist	Nov. 30, 1948
K. T. Hogan, Supervising Clerk, Grade 1	Sept. 1, 1948
J. H. Sanders, Fish and Game Patrol Captain	Aug. 31, 1948
Abe Woodard, Fish Hatchery Man	Oct. 31, 1948
Carlos O. Fisher, Fish and Game Warden	May 4, 1949
C. S. Bauder, Assistant Chief, Patrol	June 30, 1949
Cliff S. Donham, Fish and Game Warden	June 30, 1949
Chas. Sibeck, Fish and Game Warden	June 30, 1949
J. S. Hunter, Chief, Bureau of Game Conservation	Aug. 31, 1949
Raymond Coons, Fish Hatchery Assistant	Sept. 14, 1949
Frank Schulmeyer, Game Conservation Aid	Dec. 16, 1949
W. C. Blewett, Fish and Game Warden	Dec. 31, 1949
Elvin C. Anderson, Fish Hatchery Assistant	Dec. 31, 1949
Charles Ledshaw, Hunter and Trapper	Feb. 11, 1950
Ben R. Saunders, Senior Accountant	April 30, 1950
Thos. J. Smith, Fish and Game Warden	June 30, 1950
Wm. F. Kaliher, Fish and Game Warden	June 30, 1950
Bessie W. Kibbe, Senior Librarian	June 30, 1950

APPOINTMENTS

T. W. Schilling, Assistant Chief, Patrol	July 1, 1948
Leo Shapovalov, Supervising Fisheries Biologist	Jan. 1, 1949
J. F. Janssen, Jr., Assistant Chief, Marine Fisheries	July 1, 1949
R. F. Classic, Assistant Chief, Patrol	July 1, 1949
S. R. Gilloon, Assistant Chief, Patrol	July 22, 1949
Ben Glading, Chief, Game Conservation	Sept. 1, 1949
J. E. Chattin, Assistant Chief, Game Conservation	Mar. 1, 1950
P. M. Roedel, Editor, "California Fish and Game"	Mar. 10, 1950

CONSERVATION EDUCATION

During the biennium, greater emphasis was placed on better cooperation with the State Department of Education and the state colleges and schools. Five leaflets were prepared and published: "California Valley Quail," "Beaver," "Salmon," "Trout," and "Striped Bass." All were written and styled for the fourth and fifth grade levels, and each contains a color print of the species, and maps or sketches to illustrate the text. Distribution is handled by the Bureau of Textbooks and Publications of the Department of Education. Response from teachers has been tremendous, with requests for "more leaflets on more subjects."

Three of the division's motion pictures were re-edited and the narrations rewritten, especially for use in schools. These have been given "XX-Excellent" ratings by the Audio-Visual Division of the State Department of Education and are being widely used.

Active participation by the supervisor in conservation educational conferences, with lectures and pictures at workshops conducted by the various state colleges, and at teachers' institutes held in many counties has undoubtedly aided in furthering the proposed program of integrating the teaching of conservation of natural resources in the schools and state colleges of California.

PUBLIC INFORMATION SECTION

Using primarily the mass information media, the public information section attempts to inform and educate license buyers and the general public concerning their obligations toward fish and game conservation.

To better fulfill this mission, headquarters of the public information officer was transferred from Sacramento to San Francisco in March, 1949. The new location permits easier contact and closer liaison with important news media, division personnel, and the commercial fishing industry.

The 1949 Legislature authorized the appointment of an editorial assistant in the information section. Partly because of a shortage of eligibles willing to accept the comparatively low salary, the post was not filled on a permanent basis.

A major step toward standardizing the information program was accomplished in the spring of 1949. At that time, the public information officer took over the duties of distributing publications which were formerly handled from five or more separate places. Aside from technical matters, the section now handles state-wide distribution of bulletins, publications, photographs, maps, and abstracts of regulations. In addition, most telephone calls and letters requesting general information received at the San Francisco office are processed, as are requests for back issues of *California Fish and Game*, the quarterly magazine. These duties are performed by an intermediate stenographer-clerk at San Francisco.

Since inaugurating the standardized distribution program, an average of 5,000 pieces of literature were distributed by the section each month. Mail requests averaged 450 per month, telephone requests 125 per month, and personal requests at the counter, 200 per month. In addition, literature was provided for distribution at division offices and license agencies, and at fairs and sportsmen's shows.

Starting from scratch, an exhibit program was undertaken in the summer of 1948. Portable display units, capable of being shipped or carried with ease, have been assembled for exhibit use at sportsmen's shows, county fairs, and schools.

Servicing the press remains the most important function of the section. During the biennium, the mailing list of *Outdoor California* weekly was brought up to date, and the quantity of information material to the press increased. Response from publications of all types was excellent, with the division receiving more newspaper clippings than any other state agency.

The increase in the numbers of license buyers and the general interest stimulated in fish and game matters throughout the State calls for maintenance of a well-balanced information program. To assure continued acceptance of the commission's policies, and to gain ground in the solving of complex public relations problems, it seems necessary to expand these activities in keeping with the increased activities of other division functions.

LIBRARY

Early in 1949 direct supervision of the library was delegated by the executive officer as a staff function of the Public Information Section. At the same time, the responsibility for filling certain types of outside requests for publications and information was taken over by the latter section, leaving the librarian with more time to devote to serving the staff of the division, by mail and in person. The work load was also eased by the employment of a clerk-typist in July, 1949. Crowded quarters became the major problem, but a change of location is planned for July, 1950. Considerable attention was devoted to the binding of periodicals and serials. During the biennium, the collection grew to a total of 4,500 bound books and periodicals and 10,752 pamphlets.

"CALIFORNIA FISH AND GAME"

The eight issues of the quarterly journal *California Fish and Game* published during the biennium contained a total of 670 pages, with 42 major articles and many shorter notes. The material included in the magazine is largely technical or semitechnical and the subscription list includes large numbers of professional biologists, educational institutions, and libraries. The majority of the subscribers, however, are nonprofessionals who are interested in the more technical aspects of conservation work. Demand for the magazine has increased steadily and it was necessary to increase press runs from 5,500 to 6,500 copies during the two-year period.

FISCAL

Financial statements for the biennium appear in Appendix A. Total revenue for the 1948-49 (100th) Fiscal Year was $5,529,046.65; for the 1949-50 (101st) year, $5,626,113.22. These receipts are substantially greater than those for the preceding biennium: $3,556,426.26 in 1946-47, and $4,335,994.15 in 1947-48. Expenditures were $4,291,873.67 in 1948-49 and $4,530,864.64 in 1949-50.

REPORT OF THE BUREAU OF GAME CONSERVATION

Each year California's unattached hunters are finding fewer areas on which to hunt, because trespass without permission and damage to crops, livestock, fences and other property by a minority of unsportsmanlike hunters have created an unfriendly situation between sportsmen and landowners. This hostile relationship between landowners and hunters was especially prevalent in the rice-growing region of the Sacramento Valley where most of the State's pheasant population is found. Opening these areas to controlled pheasant hunting has been one of the most urgent problems confronting the bureau.

An experimental pheasant study area, the Sartain Ranch, initiated by bureau game biologists, was instrumental in the development of regulated hunting on private lands in California. Hunting on this ranch was successfully controlled in 1947 and 1948 by the bureau in cooperation with the landowner. The experience gained during these two years led to the development of a cooperative hunting plan in 1949. In this year Senate Bill No. 677 establishing cooperative hunting areas was passed by the State Legislature and was included in the Fish and Game Code as Section 1159. Rules and regulations for the management and control of these areas were then drawn up by bureau employees and enacted by the Fish and Game Commission.

In order to minimize the problem of supervision and control, and at the same time to accommodate a large number of hunters, it was required that on any prospective area a minimum of 5,000 acres in a continuous tract be open to public hunting. A provision was made to allow the landowner to collect a daily fee not to exceed $2 per hunter if he so desired, with the stipulation that 25 percent of the total collected was to be used for wildlife maintenance and habitat improvement. Three types of zones were provided for in 1949: Closed zones (for protection of crops, buildings and livestock) on which no hunting was permitted; restricted zones, on which permission to hunt was granted solely by landowners; and open zones, which were open to public hunting by permit. Restricted zones were limited in size to 20 percent of the total area; open zones had to be either a 5,000-acre tract or 50 percent of the entire cooperative hunting area, whichever was larger. The maximum number of hunters allowed at any one time was one per five acres of open land, with the stipulation that the number of hunters could be decreased as conditions warranted.

During the 1949 pheasant hunting season, six cooperative hunting areas were established by the bureau. On only one area (Sartain) was a fee charged for hunting privileges. By maintaining checking stations on each area, bureau personnel were able to control hunting, issue permits, and gather pertinent information regarding the pheasant kill. Reactions to this hunting plan were recorded and favorable responses to this type of controlled shooting far exceeded unfavorable remarks. On the Sartain area some criticism was directed toward the fee for hunting. However, most of this censure was voiced by unsuccessful

FIGURE 1. Cooperative hunting areas provide shooting for the unattached hunter

hunters. Nearly all hunters expressed wishes for cooperative hunting areas.

Table 1 lists the areas with the amount of land open to hunting, and it shows the number of hunters using these areas, their success and the reaction to this type of hunting.

One of the most impressive points of the plan was that the 24 cooperating landowners, when contacted by questionnaires or in person, were all in favor of this method of controlled hunting. Hunter damage to cooperating landowners' property was negligible during the entire season. The cooperative hunting area plan should do much to alleviate one of the largest problems confronting the bureau, namely that of opening land to hunter access where wild ring-necked pheasants are plentiful.

TABLE 1. COOPERATIVE HUNTING AREAS IN USE DURING 1949 HUNTING SEASON

Area	Number of acres open to hunting	Number of hunters using area	Number of pheasants shot	Percentage of successful hunters	Reaction of hunters to these areas by percent	
					Favorable	Unfavorable
Staten Island	7,500	5,717	1,556	27	94.2	5.8
Williams	5,000	3,906	1,193	31	96.2	3.8
Sutter Basin	8,900	6,726	2,330	35	97.4	2.6
Natomas	8,800	10,922	2,122	19	95.7	4.3
Grimes	15,800	9,377	3,518	38	92.5	7.5
Sartain*	12,450	4,518	2,733	60	76.4*	23.6
Totals	58,450	41,166	13,452	33	94.5	5.5

* Fee charged.

WILDLIFE CONSERVATION BOARD PROJECTS

During the biennium conservation activities in California received greater impetus as a result of the Wildlife Conservation Act. This act, authorized by the 1947 State Legislature, provided for a recreation program, and for the acquisition and construction of lands and facilities for the propagation and conservation of wildlife. The Legislature also provided for the creation of the Wildlife Conservation Board to formulate a conservation program and authorized $9,000,000 for financing this program. Once the plans for state-wide projects had been drafted, it became the responsibility of the Division of Fish and Game to put the program into effect by constructing, operating, managing and maintaining the projects.

All projects that entailed game conservation activities are administered by the Bureau of Game Conservation. Listed below are the Wildlife Conservation Board projects now being managed by the bureau.

GAME FARM PROJECTS

Project No.	*Name, location*	*Status*
519–7	Chico Game Farm (Butte County)	Project completed. Accounts closed with end of 1949-1950 Fiscal Year.
519–8	Marysville Game Farm (Yuba County)	Project completed. Accounts closed with end of 1949-1950 Fiscal Year.
519–9	Porterville Game Farm (Tulare County)	Project completed. Accounts closed with end of 1949-1950 Fiscal Year.
519–10	Brawley Game Farm (Imperial County)	Project completed. Accounts closed with end of 1949-1950 Fiscal Year.

OTHER UPLAND GAME PROJECTS

549	Coast Counties Quail Habitat Improvement (Central Coast Counties)	Project completed. Merged with No. 554.
503	Desert Quail Development (Desert region of Southern California)	Project completed. Merged with No. 554.
521	Owens Valley Pheasant and Quail Development Areas (Inyo County)	This project has been canceled due to opposition by lessees on City of Los Angeles lands. Project funds of approximately $45,000 have been restored to working balance of WCB.
554	Quail Habitat Development (all of California south of U. S. Highway 40, with major emphasis south of the Tehachapi)	Equipment, materials and supplies for this project are purchased by WCB. Salaries, travel and vehicle mileage are paid from federal aid in wildlife restoration funds. At present, eight full crews are working. This project will continue during the 1950-1951 Fiscal Year on essentially the same basis. During last year 401 quail "guzzlers" were completed, numerous brushpiles were constructed and springs were developed for quail use.
515	Doyle Winter Range (Lassen County)	Project completed except for construction of residence. This has been deferred pending final determination of area boundaries and land acquisition under federal aid funds.

WATERFOWL PROJECTS

Project No.	*Name, location*	*Status*
507	Butte Sink Waterfowl Management Area (Colusa County)	Area not yet acquired. Acquisition in hands of Public Works Board.
550	Delta Waterfowl Management Area (Solano County)	Land purchased March 30, 1950. Equipment ordered. Supervisory personnel hired. Federal aid development project California 40D approved effective July 1, 1950.
523	Honey Lake Waterfowl Management Area (Lassen County)	Project completed. Further developments currently being made with federal aid funds. (California FA 38-D-2.)
536	Imperial Waterfowl Management Area (Imperial County)	Project completed. Further developments currently being made with federal aid funds. (California FA 36-D.)
548	Lower Butte Creek Waterfowl Management Area (Butte County)	Area not yet acquired.
506	Lower San Joaquin Waterfowl Management Area (Merced County)	Area not yet acquired.
522	Madeline Plains Waterfowl Management Area (Lassen County)	Project completed. Further development with federal aid funds.
532	Madera Waterfowl Management Area (Madera County)	Area not yet acquired.
551	Upper San Joaquin Waterfowl Management Area (Kern County)	Area not yet acquired.

GAME INVENTORY POLLS

Another noteworthy event that occurred during the biennium was the joint game inventory poll conducted by the Opinion Research Center of the University of Denver and the bureau. Information gathered by these two surveys was used to determine the annual kill of game species, and evaluate the State's game resources. The information was obtained by instigating a dual plan as follows:

1. The Opinion Research Center contracted to furnish state-wide and regional records of the kill of the several game species. The method employed was to interview 1,250 respondents randomly selected from the 1948-49 hunting license stubs.

2. Bureau personnel selected a random sample of 2 percent of the purchasers of 1948-49 hunting licenses, distinct from the personal interview sample, which was used in mailing post card questionnaires. Information derived from the cards returned was projected to obtain the game kill by counties and for the State as a whole. In order to minimize any error in the post card answers, either accidental or by intent, a portion of the personal interview respondents were mailed coded questionnaires.

Comparison of these questionnaires with the completed interviews should indicate a correction factor which may be applied to the entire post card sample. In theory this correction factor may be used in a few subsequent years, unless there is a complete change in either the methods of hunting or the general economy of the State. The results obtained by each sampling method for the state-wide game kill are compared in Table 2.

TABLE 2. RESULTS OF GAME INVENTORY POLLS

Species	Total estimated take		Difference	
	O. R. C.	Postcards	Actual	Percent
Quail, all species	1,902,400	1,683,400	219,000	—11.5
Doves	2,359,300	2,486,000	126,700	+5.4
Pheasants	554,800	575,100	20,300	+3.7
Pigeons	347,100	318,700	28,400	—8.2
Ducks	2,853,300	3,075,500	222,200	+7.8
Geese	344,300	354,800	10,500	+3.0
Deer	90,300	100,000	9,700	+10.7
Rabbits—Brush and cottontail	761,000	575,700	185,300	—24.3
Rabbits—Jack	1,150,600	790,600	360,000	—31.2
Bear	2,800	2,200	600	—21.4
Tree squirrels	104,300	75,900	28,400	—27.2
Totals	10,470,200	10,037,900	432,300	—4.1

UPLAND GAME BIRD PRODUCTION

The production of upland game birds by state game farms reached an all-time high during the biennium when a total of 177,517 birds were liberated. Of this number 172,217 were ring-necked pheasants, 166 Reeves pheasants, 2,252 chukar partridge, 2,776 valley quail, and 106 wild stock turkeys. A summary of the game bird liberations will be found in Appendix B.

Part of this increase in upland game bird production can be attributed to the new game farms that were placed in operation. The two game farms at Porterville and Brawley were developed and enlarged from former sportsmen's groups pens that were taken over by the bureau. Three game farms of entirely new construction were placed in operation at Chico, Marysville and Los Banos.

A policy for the distribution of pheasants has now been adopted by the commission. This policy not only provides for planned releases to be made on areas open for public hunting, but also includes lands that will be closed to all pheasant hunting for five years; these closed lands are to be considered as seed stock areas. It further states that releases will not be made on lands considered to be totally unsuitable pheasant habitat.

Considerable time was spent by game farm personnel inspecting the increased number of private game farms, and checking the operation of game management areas. The work on the game management areas consisted of inspection of each area, and the banding and liberation of birds on these areas.

GAME MANAGEMENT AREAS

The game management area plan has now been in operation for 10 years. This plan was initiated in 1939 by the State Legislature as an effort to stimulate the landowners' interest in the game crop. It was intended to foster and increase the supply of upland game through land management and stocking of game farm birds. Backers of the plan believed that the income derived from the game crop would provide an incentive to the landowner to manage his land for game production. Since these areas were to be open to any licensed hunter, the income from the game produced was to be obtained by charging hunters up to a designated maximum fee for shooting privileges. Actually the income received from the game crop could not compete with the high prices being paid for farm crops which these areas could produce. The landowners also found it too difficult to control the public on these areas.

In 1947 the State Legislature modified the plan to allow for noncommercial areas where the public was excluded. These private areas are now supported by season memberships, or by a share-the-cost arrangement with the operator. Most operators are now satisfied with the plan.

There are now 43 operators who control 44,556 acres of land. During 1949 they liberated 20,720 pheasants and killed 11,539 in 5,446 man-days of hunting.

WATERFOWL MANAGEMENT AREAS

Waterfowl management areas were created not only to provide the unattached hunting license-holder with a place to shoot, but also to provide waterfowl with areas where they could feed and rest. The second part of this program includes management of land and water areas to the degree where waterfowl would be attracted to these areas and forego their depredations on the crops of surrounding agricultural lands. Until this biennium, all development and farming operations on these areas were carried out under service agreement with various contractors. This arrangement proved wholly unsatisfactory, as certain seasonal agricultural practices were not always performed at the opportune time. Starting in July, 1949, when the necessary equipment became available, all development work has been done by bureau personnel.

On these areas hunters were offered their choice of three types of shooting grounds as follows:

1. Fully developed areas with blinds for a fee of $5 per shooter.
2. Partially developed areas with no blinds for a fee of $1 per shooter.
3. Undeveloped or natural areas with no charge.

Hunting success varies with weather conditions and the waterfowl migration, but on the whole hunters expressed satisfaction with the plan.

The waterfowl management areas and the extent of their use by hunters are listed in Table 3.

TABLE 3. WATERFOWL MANAGEMENT AREAS IN USE, 1948-50

Area	Acreage open to hunting	Number of hunters checked	Number of waterfowl shot	Average number of waterfowl per hunter
Imperial				
1948-49	3,580	1,358	2,078	1.53
1949-50		1,216	1,992	1.64
Honey Lake				
1948-49	1,750	586	425	.73
1949-50		558	518	.93
Madeline Plains				
1948-49	4,775	93	37	.40
1949-50		75	161	2.15
Totals	10,105	3,886	5,211	1.34

GAME MANAGEMENT

During the biennium the number of game management districts was increased from five to seven. This expansion completed the state-wide division into districts for better supervision of habitat development and control of game populations. These districts and the corresponding game managers in charge were as follows: North Coast, Nathan Rogan; Northeastern California, Russell M. Bushey, Sr.; Sacramento, Lawrence H. Cloyd; San Joaquin, David M. Selleck; Inyo, Arthur L. Hensley; South Coast, John Laughlin; Southeast Desert, Fred Ross. It is the responsibility of each game manager to investigate game problems and apply corrective measures, also to administer bureau installations within his district. Game Manager James D. Stokes supervises the district game managers, and coordinates their efforts into a common program. Roland E. Curtis, who formerly supervised this group is now on leave with the Wildlife Conservation Board.

SPECIAL HUNTING SEASONS

ANTELOPE HUNT

The last antelope hunting season was held in 1945. From 1946 through 1948 aerial surveys showed that the number of adult male antelope was not sufficient to warrant a hunting season. However, in 1949 the antelope population had again increased and a controlled hunt for bucks only was held August 27th through September 5th in Modoc, Lassen and Shasta Counties. As in previous hunts, permits selected by lottery were issued to 500 hunters. A check of all hunters revealed that 349 antelope were shot during this season. Listed in Table 4 are the results of recent antelope hunts, and the annual antelope population as tallied from aerial surveys.

TABLE 4. ESTIMATED ANTELOPE POPULATION AND RESULTS OF HUNTS, 1942-1950

Year	Estimated antelope population	Number of hunting permits issued	Number of antelope shot	Percentage of successful hunters
1942	3,752	452	405	90
1943	5,338	452	362	80
1944	6,147	500	322	64
1945	4,739	500	307	61
1946	2,798	Hunting season closed		
1947	3,949	Hunting season closed		
1948	3,592	Hunting season closed		
1949	4,675	500	349	70
1950	3,852	No hunting season planned		

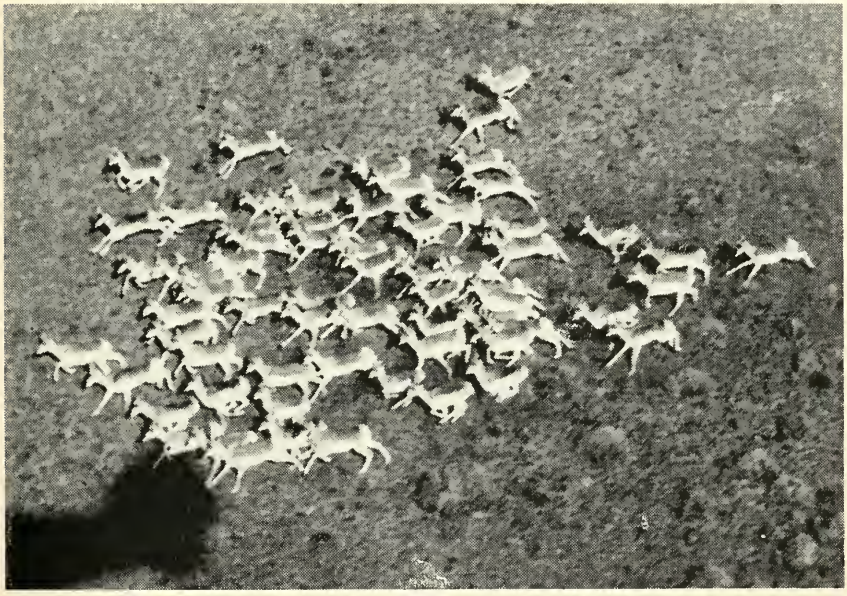

FIGURE 2. A herd of antelope in a close-up view from a Division of Fish and Game airplane

ELK HUNT

The last special hunting season for reducing the Tule Elk herd in Owens Valley of Inyo County had been held in 1943. That year 75 permits were issued by lottery for taking 75 bulls. A check of all hunters revealed that 43 bulls were harvested. Since that time population counts of this elk herd made by aerial surveys showed that the herd had been steadily increasing in numbers. By 1949 cattle ranchers, maintaining that the increase in the elk population was depleting the range, agitated for a hunting season. Consequently, a controlled hunt was held from December 2d through December 11th. A total of 125 permits was issued

by lottery for taking 75 bulls and 50 cows. Records kept at hunters' checking stations showed that 61 bulls and 46 cows were shot, for a total of 107 animals.

TABLE 5. ESTIMATED ELK POPULATION AND RESULTS OF HUNTS, 1943-1949

Year	Estimated elk population	Number of hunting permits issued	Number of elk shot	Percentage of successful hunters
1943	189	75	43 bulls	57
1944	129	No hunting season		
1945	268	No hunting season		
1946	305	No hunting season		
1947	324	No hunting season		
1948	450	No hunting season		
1949	495	125	107 (61 bulls and 46 cows)	86

CATALINA DEER HUNT

For a number of years the deer population on Santa Catalina Island had been increasing until the range suffered from extreme overbrowsing. In 1948 an attempt was made to control this population by trapping and removing deer from the island. These operations accounted for 150 deer. The deer population still remained high so in 1949 the Catalina Island Company requested a controlled hunting season for taking deer of both sexes.

A 13-week hunting season was set for November 1, 1949, to January 31, 1950, with a total of 1,950 hunting permits issued by lottery. Since permits were only valid for a one-week period, they were issued at a maximum rate of 150 per week. Checking station records showed that 724 hunters took part in this hunt, and that they bagged 246 bucks and 231 does for a total of 477 deer.

PREDATOR CONTROL

The predatory animal catch, which had been previously recorded for each fiscal year, has now been changed to a report for the calendar year. Reported here is the predatory animal catch for the 18-month period of July 1, 1948, to December 31, 1949. The report for the six-month period January 1-June 30, 1948, was presented in the last biennial report.

During this 18-month period a grand total of 5,193 coyotes and 2,081 bobcats was taken by our predatory animal hunters and trappers. A total of 5,290 other lesser predators was taken during the same period. A summary of the predatory animal catch will be found in Appendix B.

MOUNTAIN LION CONTROL

On May 18, 1948, the ten thousandth mountain lion was brought in for bounty. This lion was taken by Charles W. Bucknell of Bell Springs in Mendocino County. The first lion to be bountied was also taken in Mendocino County on October 2, 1907, by Jake Newcomer. It was in 1907 that the first bounty on mountain lions was proposed by Commissioner Fred Van Sicklen, and a payment of a $20 bounty was authorized. Com-

missioner Van Sicklen was very much interested in deer hunting, and he believed that by reducing the number of lions in the State, deer could be increased. The deer population had not yet recovered from the heavy drain of early days brought on by the hide and market hunters. In 1917 the original bounty of $20 was increased to $30 on female lions. The Legislature in 1945 authorized a further increase to $60 on females, and $50 on males.

In 1918 Commissioner Bosque recommended that Jay Bruce be employed to devote his entire time to lion hunting. Later, Charles Ledshaw was also employed. Both of these men have now retired from active lion hunting. During their hunting days Bruce accounted for nearly 700 lions, and Ledshaw 308. At the present time there are five lion hunters detailed to different sections of the State.

A total of 199 mountain lions was taken during the calendar year of 1948, and 202 in the calendar year of 1949; for a grand total of 401 lions during this two-year period. Of these 401 lions, 109 were taken by state lion hunters and 292 were bountied by private persons. State trappers operate where there have been complaints by stock ranchers which usually means they get into country that is not readily accessible to the general public.

A summary of the mountain lions taken from 1907 through 1949 will be found in Appendix B. Over half of this lion kill has been taken in the northwestern portion of the State. Other areas recording a high kill are the four central coast counties from Monterey to Ventura, and in the south Sierra from Fresno County south. Humboldt County (3,507 square miles) has bountied 1,080 lions, the largest number taken for any one county, but Lake County (1,332 square miles) with a take of 502 lions has produced more lions per square mile than any other county.

CALIFORNIA FISH AND GAME LANDS OTHER THAN GAME FARMS

Tehama Winter Deer Range with 42,896.90 acres was purchased from 1943 to 1950, inclusive, to protect winter range from natural food depletion by heavy stock-grazing. Additional purchases are pending.

Doyle Winter Deer Range with 13,429.15 acres was purchased from 1948 to 1950, inclusive, to protect winter range from natural food depletion. Additional purchases are pending.

Honey Lake Waterfowl Management Area with 3,519.70 acres was purchased from 1942 to 1944, inclusive. Additional purchases are now pending.

Imperial Waterfowl Management Area with 535.24 acres was purchased in 1948. Additional purchases are pending.

Madeline Plains Waterfowl Management Area with 5,176.10 acres was purchased from 1945 to 1949, inclusive.

Gray Lodge Waterfowl Refuge with 2,541.51 acres was purchased in 1931-32.

Imperial Waterfowl Refuge with 2,064.43 acres was purchased in 1931-32.

Los Banos Waterfowl Refuge with 3,000 acres was purchased in 1929.

Suisun Waterfowl Refuge with 1,887 acres was purchased in 1932.

FEDERAL AID IN WILDLIFE RESTORATION (PITTMAN-ROBERTSON)

The Pittman-Robertson program has expanded during the biennium until California now receives its maximum apportionment of federal aid. For the Fiscal Year 1948-49 California received $496,627.81, and for fiscal 1949-50, $478,548.26 was received. California's contribution, as required by the act, brought the total available for expenditure during the biennium to $1,300,280.75.

A total of 22 projects was in operation during all or part of the biennium. Of these, nine were of the surveys and investigations category, seven were development projects, four provided for the acquisition of lands, one was a maintenance project, and one a coordination project, which directed and supervised the other projects. Following is an account of the various projects which have been undertaken.

SURVEYS AND INVESTIGATIONS

Project 19-R, The Study of the Life History and Management of Mountain Quail in California. Emphasis was placed on reproduction, effects of man, and the food, water and cover requirements. This project was terminated as of June 30, 1950, and a final report prepared by project leader E. V. Miller.

Project 20-R, A Survey of Waterfowl Food Plants of California. This will determine the location and abundance of waterfowl food plants, and decide on areas where planting of natural foods would be feasible. The results of this study will be published as an illustrated manual of California marsh plants. Through a service agreement with the University of California, Dr. H. L. Mason is leader of this project.

FIGURE 3. This artificial quail roost not only provides roosting cover for quail, but also furnishes shade for deer

Project 22-R, The Life History and Management of the Ring-necked Pheasant in California. This project is evaluating the effects of agricultural practices on pheasant populations, especially in the Butte Sink area. Also, the survival of released game farm pheasants raised from wild stock is being compared with pheasant releases made from regular game farm stock. Management practices being tested include food and cover plantings, water development, and trapping wild pheasants in heavily populated areas for restocking depleted areas. Hunters are checked during the pheasant hunting season to determine hunting pressure, the pheasant kill, crippling loss, and the survival of released and wild birds. At the same time hunting season controls as they apply to hunters and land uses are being studied to facilitate farmer-sportsmen relationships. Harold T. Harper is the leader of this project.

Project 25-R, A Study of the Food Habits of California Game Birds and Mammals and Species Affecting Their Welfare. As an integral part of wildlife management studies now in progress in California, it is necessary to obtain information as to the food preferences of game and predatory species. C. M. Ferrel is leader of this project.

Project 28-R, A Study of Deer Population and Management Problems in California. These studies consist of an appraisal of the management problems involved, particularly in respect to range condition, deer numbers, agriculture and livestock conflicts. This project is being conducted under service agreement with the University of California with Dr. A. S. Leopold as leader.

Project 30-R, A Study of Production, Migration and Wintering Areas of Waterfowl in California. An evaluation is being made of the production and wintering grounds of the principal waterfowl areas of the State, which includes Suisun Marsh and the Sacramento-San Joaquin Delta, the Inyo-Mono and Owens Valley area, and the northeastern section of California. These studies include large scale trapping and banding operations of resident and migratory waterfowl. Also, an investigation is being conducted on the effects of reclamation projects and land uses on waterfowl populations. A. W. Miller is the leader of this project.

Project 31-R, A Study of the Effects of Brush Removal on Game Ranges in California, will determine sound methods for management of brush areas for wildlife habitat improvement. The project is under service agreement with the University of California, with Dr. H. A. Biswell as leader.

Project 33-R, An Evaluation of Quail Development and Management Practices in California. Studies are being conducted to determine the effects of cover planting and water development on quail populations. Types of construction and the value of

FIGURE 4. Installing one of the new type plastic gallinaceous guzzlers

artificial roosts are being tested. Also, the effects of cover removal, grazing, cultivation, controlled burning, rodent control, predator control, and hunting pressure on quail populations are being investigated. This project is under the leadership of Wallace G. Macgregor.

Project 35-R, A Study of Diseases of Wildlife Species in California, is concerned especially with those diseases which are of definite known importance in respect to wildlife, and which appear to offer possibilities of being controlled by management practices. Merton Rosen is leader of this project.

DEVELOPMENT PROJECTS

Project 9-D, Suisun Waterfowl Refuge, involves 1887 acres of land to provide waterfowl feeding and resting areas by construction of levees, ditches and tide gates.

Project 13-D, Gray Lodge Waterfowl Refuge, involves 2,542 acres of land to provide waterfowl feeding and resting areas by construction of levees, ditches, roads and buildings.

Project 26-D, The Restoration of Valley Quail, Gambel Quail and Mountain Quail in California. This project represents the major effort in habitat development for California quail, and includes plantings for food and cover improvement, the erecting of artificial quail roosts, and the construction of "gallinaceous guzzlers" or rain catchment basins for providing quail with water. Through this habitat development program, many areas that were formerly unsuitable as quail range are now producing quail for California's hunters. The program has received help through financial aid from county fine moneys, and physical labor from sportsmen and other interested groups.

The "gallinaceous guzzler" program has been accelerated by the use of prefabricated plastic basins and glass mat (asphalt emulsion) catchment aprons. The installation of the plastic model requires about one-fifth the time needed for the construction of the concrete type of guzzler. Another advantage gained by using the plastic model is that it can readily be moved to a new site, if the original location proves unsatisfactory.

During the biennium 574 guzzlers were installed, bringing to 734 the number now in operation.

Project 34-D, Game Trapping and Transplanting, to restock formerly occupied habitat, to extend the range of a species, and to supplement remnant species. The work consisted of live-trapping and transplanting game mammals where required. The project operated periodically only when the need for this type of work arose.

Project 36-D, Development of Imperial Waterfowl Management Area, involving 12,000 acres of land, provided waterfowl feeding, resting, public shooting areas and facilities for the proper management of the area by the construction of levees, ditches and buildings, and by the development of the land for farming of waterfowl food crops.

Project 38-D, Development of the Honey Lake Waterfowl Management Area, involves 3,520 acres of land for the provision of waterfowl feeding, resting and nesting areas and facilities for the proper management of the area by construction of levees, ditches, roads and buildings.

Project 39-D, Development of the Madeline Plains Waterfowl Management Area, involving 4,776 acres of land, provided waterfowl feeding, resting and nesting areas and facilities for the proper management of the area by construction of levees, ditches, roads and buildings.

LAND ACQUISITION

Project 10-L, Tehama Winter Deer Range. This area provides winter feed for deer migrating down from the mountains. To preserve this winter range 33,963 acres have been acquired, and more land may be purchased if it becomes available.

Project 11-L, Honey Lake Waterfowl Management Area. An area of 3,520 acres has been purchased for waterfowl feeding, resting, nesting, and to provide public shooting areas. Additional segments of land will be purchased as they become available.

Project 17-L, Madeline Plains Waterfowl Management Area. To provide waterfowl with feeding, resting and nesting areas and to furnish the public with hunting grounds, 5,176 acres of land have been purchased. More land will be acquired as it becomes available.

Project 21-L, Doyle Winter Deer Range. An area of 11,700 acres of land has been purchased to provide winter feed for the migrating interstate deer herd. Further purchases will be made as the land becomes available.

MAINTENANCE

Project 37-M. This project inspects and maintains the installations that have been developed to provide cover, water and food for quail.

COORDINATION

Project 29-C. It is the responsibility of this project to select, plan, direct and supervise the other Pittman-Robertson projects and make certain that these projects are productive of results.

DISEASE LABORATORY

Disease investigations have been greatly enhanced by the addition of a special mobile laboratory. This laboratory, built on a one-ton panel truck, was designed to fill the need for rapid diagnosis of wildlife diseases in the field. The emphasis was placed on mobility and maneuverability so that the site of a disease outbreak could be reached quickly even in areas that might be considered somewhat inaccessible. The laboratory contains all the necessary facilities for complete diagnosis in the fields of bacteriology and parasitology, making it a completely self-sustained unit.

The mobile laboratory was first used at the south end of San Francisco Bay to diagnose an outbreak of avian cholera among waterfowl, gulls and shorebirds. Several control measures were put into effect, but an estimated 40,000 waterfowl succumbed to this disease.

An extensive project is now in progress to determine the blood picture of deer, including blood chemistry, in the expectation of finding reliable factors that can be used as an indicator of the animal's condition. It is anticipated that the results of this study will form a base that can be used as an index of the state of nutrition of the deer as it relates to range management, and will incidentally classify the anemias that may occur in these animals.

Perhaps the greatest progress in disease control has been made at the state game farms. Pullorum, a bacterial disease of the intestinal tract of gallinaceous birds, has been eradicated through a control program. Other control methods have been used to eliminate avian tuberculosis in adult pheasants and chukar partridge. Studies are also in progress on controlling gapeworm infections and ulcerative enteritis-quail disease.

PUBLICATIONS BY STAFF MEMBERS OF THE BUREAU OF GAME CONSERVATION

Quarterly progress and final reports are prepared on all work conducted by the Pittman-Robertson projects. Summaries of these reports are published by the United States Department of the Interior Fish and Wildlife Service.

During the biennium other reports and articles were published by bureau personnel as follows:

Dasmann, William P.

1948. A critical review of range survey methods and their application to deer range management. Calif. Fish and Game, vol. 34, no. 4, p. 189-207.

1949. Deer-livestock forage studies on the interstate winter deer range in California. Journ. of Range Management, vol. 2, p. 206-212.

Ferrel, Carol M., and Howard R. Leach
1950. Food habits of the prong-horn antelope of California. Calif. Fish and Game, vol. 36, no. 1, p. 21-26.

Ferrel, Carol M., Harold Harper and Jack Hiehle
1949. A progress report on pheasant hunting season studies for the years 1946, 1947 and 1948. Calif. Fish and Game, vol. 35, no. 4, p. 301-322.

Ferrel, Carol M., Howard Twining and Norman B. Herkenham
1949. Food habits of the ring-necked pheasant (*Phasianus colchicus*) in the Sacramento Valley, California. Calif. Fish and Game, vol. 35, no. 1, p. 51-69.

Hensley, Arthur L., and B. C. Fox
1948. Experiments on the management of Colorado River beaver. Calif. Fish and Game, vol. 34, no. 3, p. 115-131.

Herman, Carlton M.
1949. A new host for the eye worm *Thelazia californicusis*. Calif. Fish and Game, vol. 35, no. 2, p. 139.

Herman, Carlton M., and Arthur I. Bischoff
1949. The duration of *Haemoproteus* infection in California quail. Calif. Fish and Game, vol. 35, no. 4, p. 293-299.

1950. Papilloma, skin tumors in deer. Calif. Fish and Game, vol. 36, no. 1, p. 19-20.

Herman, Carlton M., and Richard Kramer
1950. Control of gapeworm infection in game farm birds. Calif. Fish and Game, vol. 36, no. 1, p. 13-17.

Herman, Carlton M., and Merton N. Rosen
1949. Disease investigations on mammals and birds by the California Division of Fish and Game. Calif. Fish and Game, vol. 35, no. 3, p. 193-201.

Interstate Deer Herd Committee
1949a. Interstate winter deer range management plan. Calif. Fish and Game, vol. 35, no. 2, p. 103-114.

1949b. Third progress report on the cooperative study of the interstate deer herd and its range. Calif. Fish and Game, vol. 35, no. 2, p. 115-134.

1950. Fourth progress report on the cooperative study of the interstate deer herd and its range. Calif. Fish and Game, vol. 36, no. 1, p. 27-52.

McLean, Donald D.
1950. Duck banding at Tulare Lake. Calif. Fish and Game, vol. 36, no. 2, p. 75-117.

Rosen, Merton N.
1948. Hermaphroditism in the Chinese ring-necked pheasant. Calif. Fish and Game, vol. 34, no. 3, p. 135-136.

Rosen, Merton N., and Arthur I. Bischoff
1949. The 1948-49 outbreak of fowl cholera in birds in the San Francisco Bay area and surrounding counties. Calif. Fish and Game, vol. 35, no. 3, p. 185-192.

Rosen, Merton N., and Eugene D. Platt
1949. The control of avian tuberculosis in a state game farm. Calif. Fish and Game, vol. 35, no. 4, p. 323-327.

Twining, Howard, Henry A. Hjersman and Wallace Macgregor
1948. Fertility of eggs of the ring-necked pheasant. Calif. Fish and Game, vol. 34, no. 4, p. 209-216.

REPORT OF THE BUREAU OF MARINE FISHERIES

The responsibility for the conservation and administration of the ocean fisheries of California is in the hands of the Bureau of Marine Fisheries. The bureau conducts biological and statistical studies of the marine sport and commercial fisheries; and with the information thus gathered and analyzed, is able to make recommendations to the Fish and Game Commission and the Legislature for wise conservation measures. The bureau works in close cooperation with the Pacific Marine Fisheries Commission and the Marine Research Committee. Brief accounts of the activities of these organizations are presented on pages 65 and 66.

During 1948 and 1949 California's fish catch was greater than it had been in the biennial period immediately preceding, but compared with the total landings in any of the 12 years from 1934 through 1945, it can not be considered high. The catch trend reflects the success or failure of the sardine season, and the sardine fishery had not recovered from the failure which was so marked in 1946 and 1947. In 1948 the total catch was over 900,000,000 pounds and in 1949 it reached 1,100,000,000.

Among the cannery species three of the tunas surpassed previous records. Yellowfin tuna landings in 1948 were over 191,000,000 pounds. In 1949 skipjack passed the 78,000,000 pound mark and albacore totaled more than 44,000,000. Although the mackerels did not break a record the combined catch of jack and Pacific was over 112,000,000 pounds in 1948 and slightly less the following year. The 1949 sardine catch of 633,000,000 pounds was the best in four years but for the 12-year period prior to 1945 the yearly catch was in the neighborhood of 1,000,000,000 pounds. Because sardines were scarce in the years immediately preceding this biennium, a very high percentage of the fish went into cans, and this, combined with the heavy catches of tuna and mackerel, brought the 1948 case pack to 2,000,000 more than had been packed during any previous year and in 1949 the pack exceeded 13,000,000 cases.

Important among the market species, the 1948 catch of sole was over 21,000,000 pounds or almost double the 1947 peak poundage. The crab catch of 11,000,000 pounds for each year set a record for that species. Salmon landings of approximately 7,000,000 pounds for each year were lower than the record catches of the previous four years.

The value of the catch to the fisherman in 1948 was $80,500,000. The high price of fish in general and the heavy landings of tuna (yellowfin tuna, $32,000,000, skipjack, $9,000,000 and albacore, $11,000,000) combined to make this a banner year, exceeding the peak 1947 value by $2,000,000. In 1949 although the poundage was greater, chiefly due to an increased catch of sardines, the wholesale value to the fishermen dropped to $73,000,000. Prices in general were lower and the high-priced yellowfin tuna catch was less in poundage.

For the fourth year in succession the fishermen delivering to Eureka and other ports along the northern coast received over $3,000,000 for their catches; these were made up chiefly of sole, crabs, albacore and

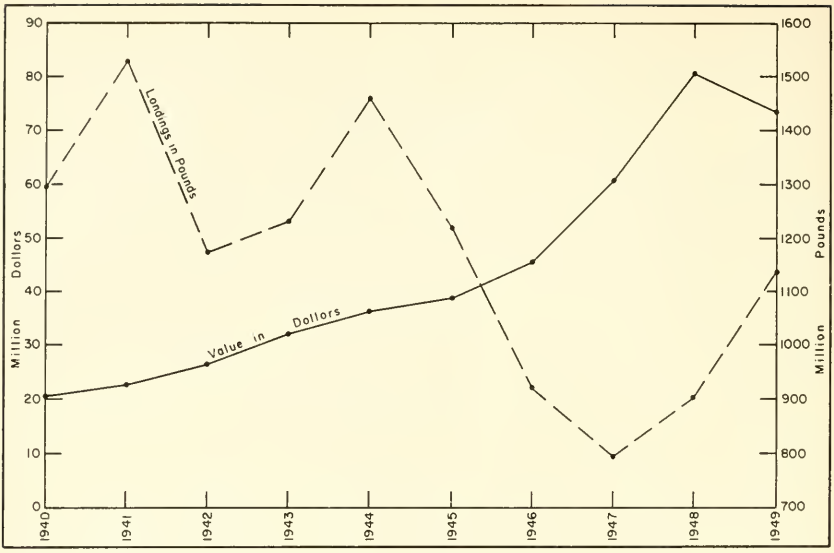

FIGURE 5. Value and poundage of the California commercial fish catch, 1940-1949. Value represents the amount paid to the fishermen.

salmon. San Francisco and Central California ports netted about $3,000,000 which was low for that region and was caused by the scarcity of sardines. Monterey fishermen received $5,000,000 and $6,000,000 for the two years, an improvement over the preceding biennium when the sardines failed to appear. The ports in the Santa Barbara region had their best year in 1948 when the total value of the landings was in the neighborhood of $2,000,000. This area is growing in importance. Canneries have been established in the vicinity of Port Hueneme and facilities have been developed for receiving large loads of sardines for shipment by truck to the canneries in Central and Southern California. Los Angeles and San Diego had their best monetary year in 1948 when the value of the deliveries was $29,000,000 and $37,700,000, respectively. The 1949 value was slightly less. Tuna was in part responsible for this prosperity, but it was also partially due to the fact that there was such a large migration of northern vessels to the southern ports.

This period has been marked by an extensive movement of the vessels in the fleet along the coast. Each year a greater number of boats and fishermen from Alaska, Washington and Oregon come south during the albacore season and remain to participate in other fisheries. In the two-year period 2,000 additional fishermen were licensed to fish in California waters (1949—14,962 fishermen) and there was an increase of over 1,000 boats in the fleet (1949—6,160 vessels). Many of the vessels entering the fleet were of larger sizes. In 1949 there were about 164 over 100 feet in length, equipped with modern devices for more efficient fishing which permitted them to go farther afield and remain on the fishing grounds for a greater length of time.

SARDINE

The present biennium saw an improvement in the sardine fishery and a steady increase in tonnage landed. From the low of 121,000 tons in 1947-48 the catch went to 184,000 in 1948-49 and 336,000 in 1949-50.* As a result the industry is in a much healthier condition than in the previous biennium. Although more sardines were available on the San Francisco and Monterey fishing grounds there were not enough fish to meet the needs of the processors in these two ports. As a result the trucking of sardines from Southern California, started in 1946-47, was continued through 1949-50. To meet this demand unloading facilities were improved at the ports of Santa Barbara and Hueneme. Most of the sardines trucked to Monterey and San Francisco were caught around the northern Channel Islands and off the mainland north of Santa Monica Bay.

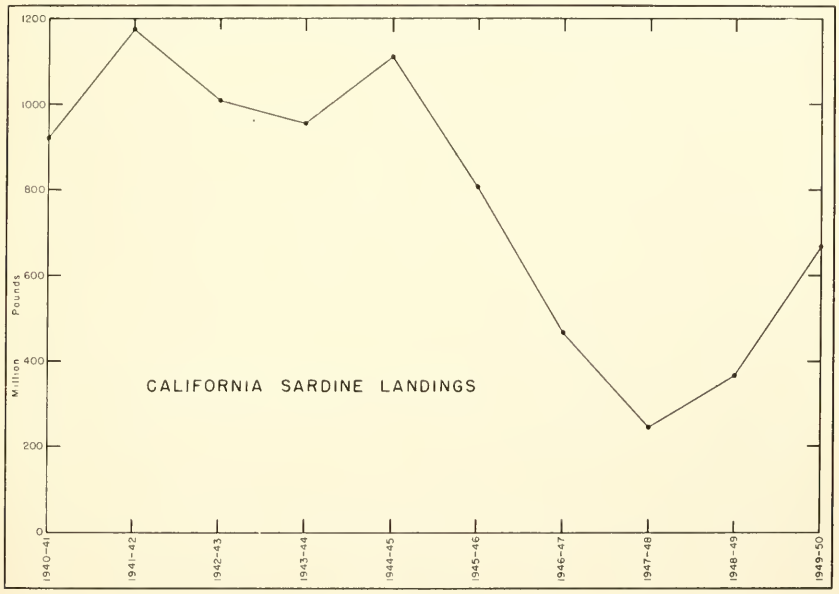

FIGURE 6. Sardine landings at California ports during the past 10 seasons

During 1948-49 about 80 percent of the sardines landed were used for canning but in 1949-50 the proportion canned dropped to a third of the total received. This was due to a strengthening in the price of meal and oil and a major drop in the price of canned sardines.

As an experiment in regulation of the sardine fishery the Sardine Industry Advisory Committee set up a temporary program of control for the 1948-49 season which was carried out by the Division of Fish and Game. Since this did not meet the expectations of the industry and proved very difficult to administer, the regulations were dropped at the

* These totals include poundages used for bait and consumption in a fresh state. They represent the final records for 1947-48 and 1948-49 and the most accurate figures available at this time for 1949-50.

end of the season. The advisory committee also discontinued its efforts to develop a long-range program of management.

The increase during the last two seasons in the tonnages landed resulted from the appearance on the fishing grounds of two fairly abundant groups of fish, those spawned in 1946 and 1947. During both the 1948-49 and 1949-50 seasons, 80 percent of the fish came from these two year classes. The 1947 group was more abundant than the 1946 and will presumably continue to make a major contribution to the fishery in the immediately succeeding seasons. If no new abundant year classes appear on the fishing grounds, the present healthy condition in the industry cannot continue for any great length of time.

As a result of the efforts of the industry a coordinated program for expanded sardine studies was set up under the direction of the Marine Research Committee during the Fortieth Biennium. This unifies the work of the California Academy of Sciences, California Division of Fish and Game, Scripps Institution of Oceanography and U. S. Fish and Wildlife Service. Although initiated in the previous biennium the expanded work at sea could not be started until vessels had been purchased and reconditioned for the specialized studies.

Routine sea investigations were begun in February, 1949, and have been continued on a monthly basis since that time. The division's research ship M. V. *N. B. Scofield* participated in the first three of these cruises in 1949 and occupied the station lines from Point Conception south to the central part of Baja California. After this time Scripps Institution and U. S. Fish and Wildlife Service had sufficient vessels to carry on the regular physical, chemical and biological sampling at sea and the *N. B. Scofield* turned to other activities of the division.

In September, 1949, the M. V. *Yellowfin* was ready for operation and she began the specific tasks assigned to the Division of Fish and Game in the cooperative sardine investigations. From October until the end of the biennium, with the use of sonar and recording fathometer, the *Yellowfin* located schools of sardines in Southern and Central California waters. Samples of the fish in these schools were taken and material for age determinations and food studies collected. Where schools were found records of water temperatures, water samples and plankton samples were taken. The purpose of this study is to determine the physical and chemical conditions where sardine schools will be found, what kinds of food are present and if the sardine shows a preference for particular types of planktonic food.

In addition to the work at sea the staff continued its routine collection of data for an analysis of the size and age composition of the catch and a measure of the success of the fishing fleet. Results of studies of the return to the fisherman based on his average monthly or weekly catch had been published through 1942. These former studies were reviewed, continued through the 1948-49 season and published as Fish Bulletin No. 76, in the last six months of the biennium. Through the cooperative study carried on with the U. S. Fish and Wildlife Service the 1948-49 and 1949-50 sardine catches were compiled by tons and numbers of fish taken in each age group. These tables were published in the July, 1949, and July, 1950, issues of *California Fish and Game*.

TUNA

Heavy exploitation of the tuna resources marked this biennium. The general expansion of the tuna industry was on a cautious note, however, as prices to the fishermen declined somewhat in January of 1950. After reaching $340 for yellowfin and $320 for skipjack, the price dropped to $310 and $290 respectively Amounts paid for other species were reduced proportionately This was caused by the large holdings of canned tuna at the end of 1949. Apparently the fast expanding industry had at least temporarily supplied the market demand for tuna. Some of the smaller canneries fell victim to this situation and were caught with no working capital to continue operations until their case pack carry-over was sold. Larger units in the industry with the advantage of national advertising had little difficulty.

Other items contributed to the anxiety of the industry, such as: relaxation of the Japanese fishing restrictions which permitted expansion to practically the full area which that nation formerly exploited; shipments of tuna and tuna-like fishes from Australia, South America and the Central Pacific, besides those from Japan; talk of canneries being built on the coast of the Gulf of Mexico; and threatened restriction of bait fishing by Mexico and Central American countries. This was more than a threat in Panama where our vessels were not allowed to take bait for some months.

The stocks of tuna held good, although long trips to Central America and the Galapagos Islands were necessary as tunas on the banks closer to California failed to supply a large quantity of fish.

The size of the tuna bait fleet increased from 136 vessels and an aggregate of 27,526 gross tons in 1946 to 225 vessels and approximately 45,540 gross tons in 1950. In addition to the purse seiners that fish tuna during the spring and summer months, there were about 20 purse seine vessels that pursued the tuna for the entire period.

Throughout the biennium the skipjack and albacore landings increased; yellowfin showed a slight decline in 1949 and the bluefin fishery

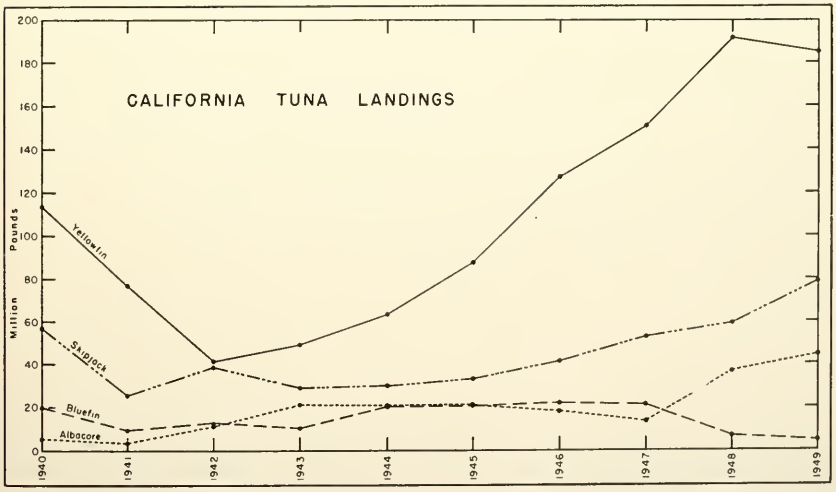

FIGURE 7. California landings of albacore, bluefin, skipjack and yellowfin, 1940-49

was almost a failure. The 1950 summer fishery for bluefin was equally poor with practically no fish landed by mid-summer.

Because of better facilities and an enlarged staff we were able to expand our tuna investigations. One trip with the M. V. *N. B. Scofield* was made to the Hawaiian Islands where much material was collected for an analysis of any differences between the mid-Pacific populations of skipjack and yellowfin and these fishes taken off the coasts of the Americas.

Several trips were made offshore and along the California coast to determine conditions which govern the presence or absence of albacore. Fish were located offshore and just prior to the regular season but no albacore have yet been taken during the winter months. On these cruises gill net and long line fishing methods were used as well as trolling.

A regular system of sampling the catch of albacore, yellowfin and skipjack has been set up to determine the sizes of fish in the catch. Preliminary studies of tagging methods have been made. In October, 1949, a meeting of all investigations studying tunas in the eastern Pacific was held at our Terminal Island laboratory. Similar meetings are planned annually to coordinate the work of all the agencies working on these fishes in the Pacific area.

SALMON

After the peak years of 1945-46, the salmon catches of California have dropped. The commercial catches of 1948-49 have been about the average of the periods since 1916 (Figure 8). The ocean catches of these

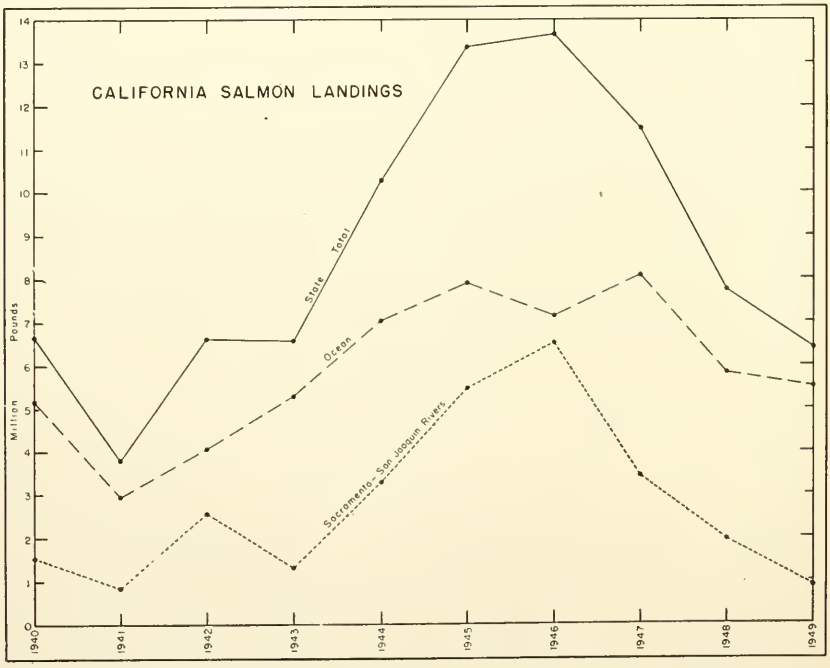

FIGURE 8. California landings of commercially caught salmon, 1940-1949, showing poundages taken from the ocean and from the Central Valley rivers

two years were approximately equal, but the river landings of 1949 were considerably lower. The difference in the river catches was primarily due to a strike by the river fishermen in the fall of 1949. In the early part of the 1949 fall season before the salmon had begun to appear in any numbers, the fishermen received about 18 cents for fish under 14 pounds and 20 cents for those over 14 pounds, and evidently expected that this price would last through the entire season. However, on September 8th fish began appearing in quantity; on September 9th the dealers cut the price to a flat 18 cents per pound, and the fishermen promptly went out on strike. This strike lasted through the entire remainder of the season; hence, the bulk of the fall run was lost to the industry. A few fish were taken by non-striking fishermen. A somewhat larger number were taken upon the orders of the union itself. Each day a few fishermen would be assigned to go out, make their catches, and deliver these catches to the union, which would in turn market the fish. The number of fishermen operating at any one time was small. The total number of fish landed during the strike was only a fraction of that which would have been landed under normal fishing conditions; but, of course, it is impossible to estimate how good the catches would have been had fishing operations been normal. Catches of the few boats that were operating and of the Division of Fish and Game boat *Striper* (which was catching salmon for tagging purposes) are not at all conclusive, but such catches indicate that the season would probably not have been much better or much worse than that of 1948.

The future of the salmon run in the main stem of the San Joaquin River looks bleak indeed. This is due to an intensification of the water supply problems which have ruined the runs for the past several years. In the Fortieth Biennial Report of the Division of Fish and Game, there is a brief description of fish rescue operations in which part of the spring salmon run of the San Joaquin was trucked past a dry stretch in the San Joaquin River. This turns out to have been a wasted effort, since it was not possible to get enough water to enable the young of these salmon to reach the sea in the spring of 1949. In order to avoid a repetition of this waste of money and effort, the 1949 spring salmon run was diverted into the Merced River instead of being trucked up the San Joaquin as was done with the 1948 run. This diverting was done by stretching a net across the San Joaquin River exactly at its junction with the Merced so that fish coming up the San Joaquin would be diverted into the Merced instead of having to back downstream any distance in order to find their way to this river. The salmon accepted this rerouting with very little fuss, probably because the small flow of return irrigation water coming down the San Joaquin was so warm that it would have been fatal to salmon to have had to stay in it for any prolonged length of time. Presumably the fish realized this instinctively and were willing to accept the cooler and more copious waters of the Merced River. Unfortunately, the salmon ascending the Merced River did not have a high rate of survival. This was because the fish ascended the river rather slowly and the great majority of them were too far downstream at the time when the irrigators started diverting almost the entire flow of the Merced River. Summer flows in the Merced are so low that salmon cannot or will not try to ascend the riffles from one pool to the next. As summer advances, water temperatures in the lower Merced become so high that the salmon are

unable to survive. The salmon which went farthest upstream found water which remained relatively cool all summer. In previous years, the salmon which went beyond the town of Snelling found water cool enough so that the survival was high. However, in 1949 the survival was poor except among the relatively few fish which got as far as the Merced Irrigation District dam about four miles upstream from Snelling.

1950 started out to be a repetition of 1949 in that there was no water available for salmon in the San Joaquin River, and in that the Bureau of Marine Fisheries erected a diversionary net at the mouth of the Merced River and started the run going up that stream. The course of events in 1950 was influenced by the outcome of a court trial in which the U. S. Bureau of Reclamation was sued to compel them to allow a sufficient flow of water to maintain the salmon runs in the San Joaquin River below Friant. Without going into the details of a very complex and confusing trial, suffice it to say that the court arranged for the Bureau of Reclamation to release a flow of 25 cubic feet of water per second which was to be used by the Division of Fish and Game to get the salmon run upstream through a series of irrigation canals. One of these canals (the Delta Canal) crosses a body of water known as Salt Slough on a flume and trestle. The desire of the court was for the Division of Fish and Game to build a fish ladder at this point so that the salmon could climb from Salt Slough into the Delta Canal at the point where the two crossed. Salt Slough gathers a moderate flow of irrigation water from the farming land in the vicinity of Los Banos. Eventually the slough flows into the San Joaquin River a few miles above its junction with the Merced. The intention of the court was for a route to be prepared by which the salmon could swim up the San Joaquin River into Salt Slough, up Salt Slough to the crossing of the Delta Canal through the fish ladder to be constructed by the Division of Fish and Game and into the Delta Canal, up this canal to its junction with the larger Arroyo Canal, and up the Arroyo Canal to the point where it was diverted from the San Joaquin River, thence up the San Joaquin to the spawning grounds in the vicinity of Friant Dam. Unfortunately this court directive came too late to be effective as far as the 1950 salmon run was concerned. The order was issued in mid-May. Construction of a fish ladder of this height (12 feet) is a matter which usually requires many months of red tape and construction time. On this occasion the red tape was dispensed with in a matter of hours. Bids were obtained, one was accepted, and the ladder was operating on June 16, 1950, about a month after the issuance of the court order. This was far too late. To have been effective the ladder should have been in operating condition about May 1st, a matter of several days before the court's totally unexpected action. As it was, the bulk of the salmon run went up the Merced River and only 36 fish availed themselves of the fish ladder which was constructed for their use. By June 26th it was obvious that the salmon run was over. Water temperatures in Salt Slough were so high that there was no chance of any more fish getting upsteam to the ladder. Hence, by agreement with the division, the Bureau of Reclamation turned off the flow of water which was being used for these fish. The spring run of 1950 was officially declared ended.

The program for the construction of fish screens and ladders has received tremendous impetus from additional funds made available under the Wildlife Conservation Act. However, as in any other long

range and large scale program the mechanics of operation have been slow of achievement. The engineering help necessary for the drawing up of plans for large projects is now more readily available than when the Wildlife Board first began to make allocations of funds.

Detailed plans have been completed for the construction of two fish ladders on the Daguerre Point Dam on the Yuba River. This location is about 10 miles above Marysville. Plans also have just been finished for the construction of a fishway on the Sutter-Butte Dam on the Feather River. This dam is located about 10 miles below Oroville.

FIGURE 9. Mill Creek electric fish screen

The fish screen shown in Figure 9 has been built at the heading of the Los Molinos Water Company on Mill Creek. This site was chosen because of its suitability for further experimentation on electrical screening. Electric fish stops so far have not been very successful. This screen incorporates several new ideas in its construction and hope is held that a truly effective electric screen may yet be produced.

Four small wooden fish ladders were installed in gravel diversion dams along the Merced River. Their effectiveness has been doubtful due to lack of water at the proper time. This lack of water during the salmon run is not so much due to lack of runoff as to the mismanagement of this flow. Almost the total flow of the river is impounded early in the salmon season often allowing sections of the stream bed to dry up. Later when the dam is full, a larger spill occurs which is often damaging to both small diversion dams and their fish ladders. A more extended period of water release would make a great difference in the salmon production potential of the Merced River.

The Division of Fish and Game has worked closely with the U. S. Bureau of Reclamation in the designing of a fish screen for the Tracy pumping plant. When completed this diversion will be the largest in the

State; and as its water will be drawn from salmon streams, a screen has been considered necessary. This installation is also expected to save large numbers of striped bass and other species of fish. Bids have already been received for a pilot screen 200 feet long to be located in a temporary channel. This structure will be adequate for the diversion capacity of the first three years of pump operation. The pilot screen will contain several types of debris-cleaning mechanisms and should give the information necessary for the designing of an effective permanent installation. During the life of the pilot screen it is planned to transport the small fish out of the danger area by barge.

The construction of a building at Elk Grove has supplied a much needed headquarters and shop for the men working on stream improvement in the Central Valley. This shop when finished and equipped with power tools will greatly increase the efficiency of the personnel working in this area. This installation was constructed with funds provided by the Wildlife Conservation Board.

As part of an interstate investigation involving California, Washington, and Oregon, the Bureau of Marine Fisheries has started tagging salmon in the ocean. Taggers have been working out of San Francisco, Fort Bragg, and Eureka. In addition, the bureau has tagged salmon in the Sacramento-San Joaquin Delta as part of an investigation which is unconnected with the Pacific Marine Fisheries Commission.

TABLE 6. NUMBERS OF SALMON TAGGED

Area	Silver	King	Total
1948			
Eureka and Fort Bragg	143	662	805
San Francisco	----	2	2
Sacramento-San Joaquin Delta	----	2,573	2,573
Totals	143	3,237	3,380
1949			
Eureka and Fort Bragg	69	461	530
San Francisco	1	371	372
Sacramento-San Joaquin Delta	----	864	864
Totals	70	1,696	1,766
January 1-June 30, 1950			
Eureka and Fort Bragg	28	376	404
San Francisco	2	809	811
Sacramento-San Joaquin Delta	----	----	----
Totals	30	1,185	1,215

The numbers of fish tagged are shown in Table 6.

An innovation in tagging methods, tried for the first time in 1949, was moderately successful, and was tried again in 1950. The second time it was an overwhelming success. Sport fishing boats operating out of San Francisco Bay were contacted before the salmon season opened. Arrangements were made with 15 boats to donate their time and catch salmon for tagging before the season was open. This included 11 charter boats, three private boats, and one commercial troller. Each charter boat's skipper contacted some of his best customers and asked them if

they would like to go salmon fishing without charge, the reservation being that they were to donate all fish for this tagging program. The idea appealed to the sportsmen and the skippers had no trouble obtaining full crews. The Division of Fish and Game furnished a minimum of one tagger to go with each boat. On a few boats, two taggers went along.

On the twenty-sixth of March, 1949, this armada put to sea, and spent the morning and early afternoon fishing for salmon. Fishing was only fair and 69 fish were landed by the 15 boats. This operation did a great deal to promote better understanding between the division and the boat operators and the sportsmen, and it was decided to repeat in 1950. The 1950 salmon season opened earlier, i.e., on March 1st; hence, it was decided to hold "Tag Day" on February 26th, the last Sunday before the opening of the season. Operations were much as in 1949, except that the weather was a little better and the fishing was a great deal better. Twenty boats tagged a total of 365 salmon during the day's operations. Twelve fish were killed during the course of the tagging operation. These were all turned over to charity.

The most important result of this ocean tagging has been to show that the great bulk of California's king salmon originate in the Sacramento-San Joaquin River systems. An earlier tagging experiment conducted from 1939 to 1942 also demonstrated this fact. The present experiment confirms the older findings and conclusively demonstrates that if we are going to have a salmon fishery either in the river or the ocean, we are going to have to be very careful about what happens to the spawning beds of the Sacramento-San Joaquin River systems.

Interesting but much less important than the mass movements of salmon into the Sacramento-San Joaquin Rivers are the occasional long range and high speed movements shown by a few individual fish. One king salmon went from San Francisco to southern Canada in 31 days. Another made the trip to the Columbia River in 22 days. One salmon tagged off Oregon was recovered in the Tuolumne River. Another tagged off the Washington coast was recovered in the Sacramento River. One tagged off southern Canada was recovered off New Years Point, between San Francisco and Santa Cruz.

Silver salmon are much less important in the California fishery than the kings. The landings of silvers amount to only about 10 percent of the State's total catch. Tag returns show that the movements of silvers in no way resemble those of kings. Most of the recoveries from California-tagged silvers were made in the waters off Oregon or in Oregon streams. This northward movement shows in returns from both the 1939-42 tagging and from the present tagging experiment.

Another experiment involving cooperation by the States of California, Oregon, and Washington was the marking of salmon in the rivers of the three Pacific Coast states in order to determine what streams were providing what percentage of the marine catches of salmon in what specific areas. This work was started in 1950. California's share was to include the marking of 200,000 hatchery-reared fish from Coleman Hatchery on Battle Creek, 200,000 wild fish from the Sacramento River and 200,000 fish from a coastal hatchery. As actually carried out, the work included 234,000 wild fish from the Sacramento River (marked by removing dorsal and left ventral fins); 235,000 from Coleman

Hatchery (marked by removing dorsal and right ventral fins); and 137,000 from Prairie Creek Hatchery near Orick (marked by removing anal and left ventral fins). It was expected that the wild fish could be caught by the use of seines, since this method of catching young salmon had proved quite successful in the American River and in some of the rivers of the San Joaquin Valley. However, when seines were tried in the Sacramento, they proved to be utterly inadequate as only a few hundred fish per day could be obtained. The method of attack was immediately shifted and 22 fyke nets mounted on rectangular frames were built and set in the riffles of the Sacramento River. These nets did the job, but the proper setting of them proved to be quite a task. If they were placed in water which flowed too slowly, they did not catch enough fish. But, if they were placed in water which flowed too rapidly, they caught many fish but killed most of them. Intensive experimenting was required to find suitable places, but once these spots were found the nets produced an entirely adequate supply of good healthy fish. The wild salmon were carried to Coleman Hatchery, marked by the same crews that were marking the hatchery fish, and then returned to the Sacramento River.

Coleman Hatchery is operated by the U. S. Fish and Wildlife Service, which donated the hatchery fish and the facilities for marking hatchery and wild fish in that area. The Coleman Hatchery staff took an interest in this work, made suggestions of great value and gave us a list of experienced fish markers residing in that area. The division wishes to thank the U. S. Fish and Wildlife Service and John Pelnar, the district supervisor who is in charge of Coleman Hatchery.

MACKEREL

The Pacific mackerel fishery remained at a relatively low level during the biennium. The 1947 year-class, which formed a large portion of the catch in 1947-48, continued to support the fishery in 1948-49 and 1949-50. Landings in the Los Angeles region, which account for virtually all of the State's catch, fell to less than 37,000,000 pounds in 1948-49—the lowest figure since the fishery became of major importance in 1933. In 1949-50, landings rose to nearly 49,000,000, a substantial gain but still far below the record season of 1935-36 when about 130,000,000 pounds were processed. Both scoop and seine boats were active. In 1948-49 scoop fishermen caught nearly 28,000,000 pounds and seine fishermen 9,000,000. Preliminary figures for 1949-50 show roughly equal catches for each type of gear. State-wide landings were approximately 38,000,000 pounds in 1948-49 and 50,000,000 in 1949-50.

Routine sampling of the commercial catch continued without interruption. These samples provide the basic information regarding the size and age of the fish which enter the fishery. Studies of the age composition of the catch for the period 1939-49 were completed. At the close of the biennium the data were being compiled in manuscript form. Results of the tagging program were published as Fish Bulletin 73 in 1949. This program was inaugurated in 1935 and the last tagged fish were recovered in 1947.

The fishery for jack mackerel is carried out almost exclusively by seiners. Landings were substantial, though far short of the banner 1947-48 season when the catch passed 142,000,000 pounds. The state-wide

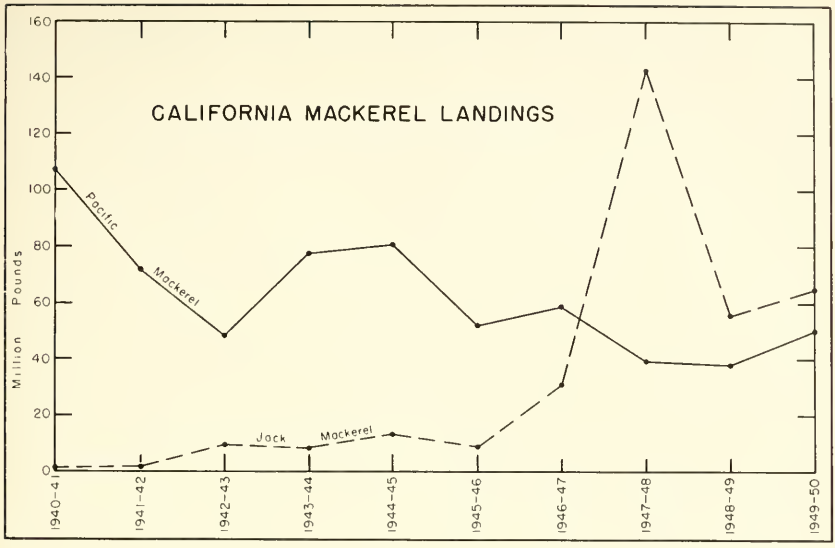

FIGURE 10. Landings of Pacific and jack mackerel for the past 10 seasons. The mackerel season is considered to start in May and end in April.

catch in the 1948-49 season was nearly 56,000,000 and in 1949-50 about 60,000,000. Los Angeles region landings produced by far the greatest tonnage: about 43,000,000 pounds in 1948-49 and over 54,000,000 in 1949-50. The Monterey region reported landings of approximately 9 and 4 million pounds in the two seasons and the Santa Barbara region roughly 4 and 1 million.

Investigations of the jack mackerel, begun on a limited basis in 1947, were gradually intensified. The original program included studies of the size and age composition of the commercial catch. This work is being continued on a routine basis. In 1948, a study of the populations in the Central and Southern California areas was inaugurated. This led to a broader study of the distribution of the species along the entire Pacific Coast. A considerable body of data bearing on these problems was obtained and was being analysed at the close of the biennium. Maturity studies were started in 1949. These must be continued for at least another year before any conclusions can be reached. Finally, a survey of fishing localities is being made as time permits.

BOTTOM FISH

The otter trawl fishing for sole, sand dabs, flounder, turbot, rockfish, and other bottom fish takes a greater tonnage of fish than any other fresh fish industry of the State. The landings of flatfish and rockfish for the last ten years are shown in Figure 11, but this graph does not tell the entire story. Rockfish used to be taken primarily by means of hook and line, but a type of trawl was developed which was quite satisfactory for catching theme in quantity. This, combined with the almost mlimited demand for fish products during World War II, resulted in the boom of the rockfish fishery which reached its peak in 1945. The subsequent

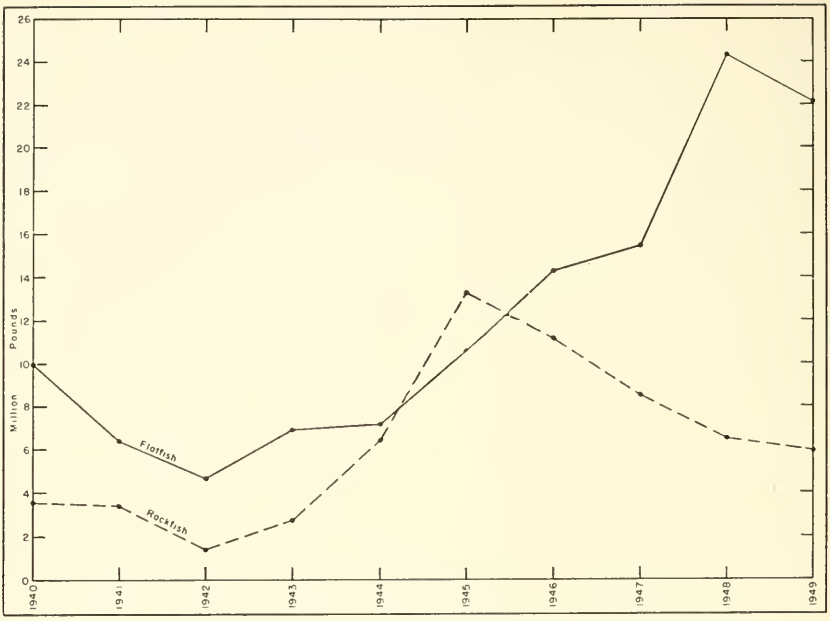

FIGURE 11. California landings of rockfish and flatfish (flounder, sole and turbot)

decline has resulted partly from poor market conditions and partly from a shortage of rockfish on some of the banks. The increase in catches of sole has resulted from a steady increase in the number of boats, increase in the efficiency of gear, development of new fishing grounds in waters deeper than were formerly fished, and in the utilization of species formerly regarded as trash fish. For example, the previously unutilized Dover sole now provides the largest poundage of any single species of flatfish. The increased use of this species was largely responsible for the fact that the catch of flatfish in 1948 was the greatest ever recorded in the State's history. The industry is just beginning to take large quantities of scaly-fin (Bellingham) sole, another formerly unutilized species.

In spite of the increase in total landings, the trawl fishery is not as healthy as it would seem. There has been a decided decline in the catches of previously utilized fish and to some extent in the Dover sole, a condition that has seriously worried the industry. Part of this has doubtless been due to a great increase in the number of boats, but part of it has also been due to unnecessary waste of small fish, and the resulting decline in the numbers available. Prior to 1940, the trawlers were company-owned, and there were relatively few companies. At the suggestion of the Division of Fish and Game these companies voluntarily limited themselves to the use of nets with a bag of five-inch mesh or greater. This permitted the escape of large quantities of small nonsaleable flatfish. In more recent years the boats have been operated by individual owners; hence, the old agreement between the companies no longer held. The boats have been using nets with a mesh as fine as $2\frac{1}{2}$ inches, and the use of such gear resulted in the loss of large quantities of fish which

would have grown enough to be saleable in another year or so. A result of this condition was the industry's agreement to the passage of a law limiting otter trawls to a mesh of 4½ inches. The 4½-inch mesh requirement now enforced corresponds quite closely to the pre-1940 five-inch mesh voluntary agreement. This is because in the older agreement the mesh size was measured from center of knot to center of knot; whereas, the modern law requires that the measurement be of the clear opening between the knots. When the present law was passed, it stated that the nets should be five inches clear opening between knots, but this was later reduced to 4½ inches at the request of the industry. It is too early for this mesh-restriction law to have shown any results in the improvement of the fishery.

Work on the trawl fishery by the Bureau of Marine Fisheries has included a study of the trawl boat logs, going into some detail as to the species caught, the catch localities, catch depths, and so on. All this work is necessary in order to keep an accurate track of the conditions of the fishery and its progress from year to year.

Research work on the vessel *N. B. Scofield* has included a study of the effects of different sizes of trawl mesh on the release of young fish, and some exploratory work to determine the fishing potential of the deep sea off the coast of California.

Several species of bottom fish have been tagged in order to learn something about their movements and rate of survival. We have been getting excellent cooperation from fishing boat crews in the return of these fish. This is especially gratifying in view of the fact that on board a trawler flatfish are definitely a bulk product, and the fishermen must keep their eyes open in order to spot the tagged individuals. Inevitably some tags are missed by the fishermen. Many of these are found and returned to us by the men and women in the fish processing plants.

Almost all of the returns of flatfish tags have been made within 20 miles of the place where the fish were released, showing that most of the species move relatively little. Exceptions to this were two English sole which were tagged off Eureka and recovered off San Francisco.

SABLEFISH

The sablefish (black cod) fishery of the Pacific Coast has shown alarming signs of depletion. Concern for the future has led the industry to request that the Pacific Marine Fisheries Commission start an investigation of the species. The commission in turn has asked that the biological staffs of California, Oregon, and Washington start this work.

Before a suitable conservation program can be developed, it is necessary to know whether we are dealing with a single coastwide population of sablefish or with a number of smaller populations each of which remains in a somewhat restricted area. In order to answer this question all three states are tagging sablefish to determine the extent of their movements. As another way of getting at the same problem, the three states, Canada, and Alaska are all collecting sablefish samples for shipment to the California State Fisheries Laboratory at Terminal Island where meristic counts are being taken and where a comparison is being made between fish from the different areas.

FIGURE 12. Fishing for sablefish. Hauling in a long line from a depth of 400 fathoms, with the aid of a line puller. *Photograph by J. B. Phillips, Monterey, California, March 1, 1950.*

Work is also being done to determine the rate of growth, weight-length relationship, size at maturity, and spawning season.

The California landings of sablefish in no way reflect the abundance of the species. As a rule small individuals (under five pounds) are not wanted by the markets, but during World War II the markets were able to sell such fish and the drag net boats brought in great quantities. The postwar drop represents a return to normal marketing conditions.

Sablefish are marketed fresh, filleted and frozen, smoked, and salted, and some recent canning of fillets has proved successful. The flesh is oily and of pleasing texture. This species is found from Southern California to Alaska. It is caught on baited long lines and is also caught by use of drag nets. It has been taken commercially in water as deep as 400 fathoms and in shallow water, close to shore. In the winter, there appears to be a greater concentration of larger individuals in deeper water, while in the spring and summer there is a shifting into somewhat shallower water, with the smallest fish in the shallowest water. Spawning occurs mainly during the winter months.

CRABS

The crab fishery, although producing a luxury food, underwent a tremendous expansion during the last few years. Shortly after re-establishment of the industry after the war, the total seasonal landings rose to more than double those of prewar years. San Francisco has been surpassed by Eureka in total poundage of crabs landed beginning with the

1945-46 season. This has been the result of increasing the total fishing effort in the Eureka region where prior to 1944 the resource had not been fully harvested. During the same period more intense fishing has gradually increased the seasonal landings at San Francisco to about five and one-half million pounds which is about 2,000,000 pounds above the prewar level.

Crab traps of stainless steel wire woven about circular frames have become the principal fishing gear. However, there are still many smaller boats in both the San Francisco and Eureka regions contributing to the total landings through the use of the hoop nets which once were the mainstay of the fishery.

Since there must exist a limit to the amount of exploitation of the resource in relation to the natural production of the species, it became advisable in 1948 to begin a biological investigation of the crab to determine if this resource can withstand the increased fishing pressure.

The existing protection of females and the minimum size limit restrict fishing to a definite group of older male crabs. When these are taken crabbing must cease—but only until after the ensuing molting season which brings in a new group of legal-size crabs. Preliminary studies of the present biological investigation are yielding information on the rate of growth and size at first maturity of the crab in California waters. Crabs about to shed their shells are held in fresh circulating sea water at the Steinhart Aquarium, San Francisco. The growth of these crabs after molting gives increments of the various sizes. The seasons of molting for different size groups are being ascertained and considered with periodic growth increases to give data for construction of the desired growth curve. Determination of the size and age at first sexual maturity will allow an estimation of the possibility of the intensive fishing operations resulting in irreparable damage to the resource. There is indication that legal-size crabs have passed through two mating seasons. Thus, it seems, since natural production has opportunity for success, that only a catastrophe for the females or the young stages could harm the fishery for an extended period.

PISMO CLAM

After September, 1947, there was no legal commercial exploitation of California Pismo clams but limited quantities have been imported into the State from Mexican waters to meet the consumer demand. During 1948 there were no records of shipments into California from south of the International Boundary. In 1949, however, the imports amounted to about 645,000 pounds live weight. Reduced canning is the major factor responsible for the drop in importations from a high of over 53,000,000 pounds in 1945.

In October, 1949, Fish and Game District 18A (the LeGrande sanctuary just south of Pismo Beach) was open to the sportsmen of the State for the first time in 20 years. During a two and one-half month period following this opening an estimated 4,000,000 pounds were removed from this beach. At the same time that District 18A was opened, two other areas (one at Pismo Beach and one at Morro Bay) were closed to clam digging. It is anticipated that designated areas will be set up as clam sanctuaries and alternately opened and closed approximately every

five years, thus allowing a given population of clams limited protection for short periods.

Pismo clam investigations, re-established in 1946, indicate that there have been no exceptionally successful sets at Pismo Beach since 1946. A review of available information about the Pismo clam was prepared for publication in *California Fish and Game*, July, 1950, and a more technical report on populations, maturity and local growth rates is being prepared in conjunction with Dr. Wesley R. Coe of Scripps Institution of Oceanography.

ABALONE

The production of abalones has increased slightly over that of the last biennium. Because of the great increase of abalone divers after the war, the drain on District 18 was excessive and practically all of the legal-sized abalones were removed. Most of the abalones now come from the Channel Islands. The present diving crews are the old timers who have followed the fishery for years. Only a few of the postwar semi-professionals have stayed in business. A new species (*Haliotis sorensenii*) described from a few specimens taken near San Simeon has been discovered in commercial quantities around San Clemente Island. The center of the industry is at present at Santa Barbara where a large modern plant processes the abalones as they are landed from the islands. Morro Bay has two processing plants which produce a small steady supply.

OCEAN SPORT FISHING

Ocean sport fishing has shown a continual rise in numbers of boats and fishermen since the end of the war. The increase in numbers of boats and fishermen between 1947 and 1948 was 21 and 22 percent, respectively, but the increase in total number of fish caught was only 8 percent. If the stock of fish was sufficient, the total ocean sport catch could be expected to increase in proportion to the number of fishermen.

Spot checks of sport boat landings, made continuously since 1947, have revealed that the average catch of the marine angler is about five fish of all species. The number of anglers catching 10 or more fish during any one day of angling averaged less than 10 percent of the total anglers throughout the season. Seventy-five percent of the anglers caught five or less fish during an average fishing day. In fact, over half of the 234 boats checked during 1948 and 1949 reported an average catch of three fish or less per fisherman.

Before 1949, holders of sport fishing licenses were permitted to take 15 fish in the aggregate of certain species. Beginning in 1949, the regulation was changed to a bag limit of 10 fish of certain species, and several additional species were placed on a limit of 15 fish. This new regulation was intended to perform two functions: to help eliminate some of the waste of fish that often occurs when an angler returns with a heavy catch and has difficulty in disposing of it, and also to distribute the available fish more evenly among the anglers. This would be accomplished by causing the highly successful angler to give his overlimit fish to those anglers that were less successful. Preferably, of course, it is better that an angler cease fishing if he reaches his limit, or releases alive overlimit fish.

There has been little change in the species composition of the marine sportcatch. The important ones are barracuda, the popular kelp and sand bass (frequently called calico bass), the many species of rockfish, halibut, white sea bass and yellowtail. Perhaps the backbone of the Southern California sportfishery is the kelp and sand bass. Until the spring of 1950, very little research work on these fishes had been done. At the present time an experimental tagging program is in effect and a total of more than 1,200 fish have been tagged. This venture is a cooperative one between several groups: the Bureau of Marine Fisheries, sportboat owners, boat landing operators, live bait dealers, a tackle manufacturer, the Southern Council of Conservation Clubs, and the Sporting Goods Dealers Association of the Los Angeles area. Only because of the friendly efforts of all of these groups, and many individuals as well, has it been possible to put on this tagging program to the extent necessary.

FIGURE 13. Tagging rock bass

It is far too early to explain any definite results, although information is coming in at an unusual rate.

In keeping with a policy set up in the summer of 1948, the bureau has maintained monthly news releases summarizing the marine sportcatch all along the California coast. The value of such a policy is manifold, but most important it does much to convince boat operators that they personally profit by keeping and sending in catch records that will be used as public information.

LIVE BAIT FISHERY

There has been little if any change in the past two years either in the manner in which live bait fishermen operate or in the handling of the catch records that these fishermen maintain for the bureau. The kinds and amounts of fish taken daily by the fishermen have been reported to us and we have accompanied as many bait boats as possible during each season. On these trips much information is gained that does not appear on the catch records and at the same time good relationships are maintained.

During this biennium, the bait reports indicated that practically no small sardines were caught on the bait grounds of Southern California. The total bait catch has increased and adult sardines form a larger part of the total than was true in the 1946-1948 Biennium.

SHARKS

Since before World War II the shark fishery in California has been primarily for the purpose of obtaining vitamin A from the liver oils. Within the last few months, this industry has died a rather sudden death. In California waters the vitamin fishery has depended primarily upon soupfin sharks. Dogfish were of secondary consideration. The soupfin has been subject to a very intensive fishery and has shown signs of extreme depletion. Soupfin liver prices advanced to a point where first-quality male livers were bringing as much as $1 per ounce. Even at this fantastic price, the fish were so scarce that many fishermen were dropping out of the business, being unable to make a living. Early in 1950, there were extensive imports of much cheaper shark liver oils and the development of artificial vitamin A. Between them, these two occurrences forced the price of soupfin livers from $16 per pound down to about $2.25 per pound and made it impossible for the few remaining soupfin fishermen to stay in business. A corresponding drop in dogfish liver prices has made it a practical certainty that, barring a major economic upheaval, there will be no dogfish fishery when the species becomes available to the trawlers this coming winter.

SEA LIONS, SEA ELEPHANTS AND SEA OTTERS

The sea lion population seems to have changed little in the past two decades. A considerable increase in numbers has been noted at Santa Barbara and San Nicolas Islands which is offset by a decrease in other places. The increased activity of the Navy at San Miguel and San Clemente Islands has caused most of the animals that previously used those islands to move away.

The protection given the sea elephants for many years in Mexican and California waters is beginning to show results. Several hundred can usually be found about the Channel Islands. Sea lion surveys in the late twenties did not reveal a single sea elephant in California waters.

The sea otters, inhabiting the stretch of coast between Monterey and San Simeon, appear to be maintaining their numbers. Several of the animals can usually be observed in many of the protected coves in this area.

KELP

Of the several seaweeds occasionally gathered, only one, the giant kelp, is utilized in quantity. Two firms are engaged in harvesting giant kelp. One is located at San Diego and produces alginates which are in demand for a number of industrial purposes. The second, at San Pedro, produces some medicinal products but the bulk of its output is powdered kelp used in mixture for stockfoods, especially for poultry, hogs and dairy stock.

The financial return to the State from the tonnage tax on harvested kelp and the leasing of beds is small. In recent years the harvest has averaged about 57,000 wet tons of kelp per year. This is but a small fraction of the amounts cut during World War I. The interests of the State are fully protected by detailed laws governing the leasing of beds and methods of harvesting. It is noteworthy that through the years no court actions have been necessary.

The effects of kelp harvesting have been studied by various agencies over the past 30 years and the results have been reported in Federal and State publications. This natural resource is unique in that utilization tends to improve the original supply. Supervised harvesting results in a more healthy growth in the beds with less breakage from wave action and less litter to wash ashore. Valuable products are being produced from this resource without injury to the beds, to the fisheries, or to the recreational areas of Southern California.

FISHERIES STATISTICS

Accomplishment in the statistical unit during the past two years has been possible because for the first time in many years the clerical staff quota was filled and there were men placed in training for the field work which had long been neglected. With the weight of detail lifted the supervising staff had time to devote to an overhaul of the tools for collecting and the mechanics for handling the record of the billion pound catch. Conditions had changed rapidly in the fisheries, in the fleet and in the industry in recent years and the demand for statistical summaries was increasing.

After careful study revisions were made in most of the forms from which the fisheries statistics are compiled. Because these simple forms had been carefully planned they had met many of the gradual changes in conditions and given adequate information over a long period of years. We were reluctant to make them more complex but the postwar adjustments in the fisheries and the industry had brought changes that could not be recorded on the simpler form. On the fish receipts, for example, it was necessary to get a record of gear on every catch because the fishermen were using so many kinds and changing gear so often that the yearly boat registration which recorded gear for each vessel could not give sufficient information to enable us to follow these changes. It was also necessary to ask for three locality records; the water area where the fish were caught, the place of first landing and the final destination of the fish. At times the vessels do not unload at the cannery or market dock as they did in the past but deliver their catch hundreds of miles away to a barge anchored on the fishing grounds or to a truck at a

remote wharf. For similar reasons changes were necessary in nearly every form that was in use.

The serial number on the Fish and Game boat plate acts as an identifying code in the statistical system. The first boat plates were issued in 1931 and many of these were lost or painted over so that the serial number could not be read. During the war it had been impossible to get rust proof metals and the plates made during that time had quickly deteriorated when exposed to the salt water. In 1949, therefore, the boat plates in the series from 1 through 7000 were replaced without cost to the boat owner provided the vessel was properly registered for commercial fishing or had a party permit for sport fishing.

Renewing the boat plates came at an opportune time to stress the importance of the boat identification on the fish receipts and the need for proper registration of the vessels. Dealers had become careless about identifying the vessels by Fish and Game number on the fish receipts; owners had neglected to register their vessels each year. Replacing the boat plates has produced most beneficial results to the statistical system. By stressing the identification of the boat by number on the fish receipts it has improved the records we get from the fish dealers and therefore reduced the clerical work; it has stimulated interest in the boat registrations and the necessity for boat plates.

In 1949-1950 there were 1,000 more vessels in the active fishing fleet than had ever fished in California waters before. Among these were 100 additional sport fishing boats; there was a high percentage of larger vessels (164 over 100 ft. long) and more than the usual number (424) had come from Alaska, Washington and Oregon to join the local fleet. There was also a more noticeable movement of the vessels up and down the coast and the records of individual vessels were getting more complicated.

Fish Bulletin No. 74, eleventh in a series of catch bulletins fostered by the statistical unit, was published in 1949. This bulletin presented the detailed catch statistics for the year 1947 which was routine, and in addition a review of statistics for the period 1916-1947. This gathered into one convenient place comparable records gleaned from many former publications. Members of the research staff analyzed the graphs and tables presented for both minor and major species and told the historical story of each fishery. Because of the scope of this bulletin it has many uses, one of which is as a source of ready reference for information concerning the less important species which receive little attention elsewhere.

In addition to the record of first sale of fish to a dealer, the Bureau of Marine Fisheries receives monthly reports from the processors of the State. These show details of kinds of fish handled and the amounts of canned fish, fish meal and oil and other products produced. Formerly the data from these reports had been compiled into monthly summaries by the San Francisco office and released to interested persons. During 1949 the handling of these reports was transferred to the Terminal Island laboratory and changes were made in the monthly summaries issued. These changes were based on suggestions received from members of the industry.

Circular 23, compiled from the processors' reports for 1948 separated the record of the packs of jack and Pacific mackerels and gave more

detail on the tuna packs than was customary. Circular No. 24 which covered the processed fish for 1949 added a recapitulation of the case pack of tuna, bonito and yellowtail for the period 1918-1949. This summary was presented at a time when the industry and the Federal Food and Drug Administration were cooperating on a program for standardizing the tuna pack and this information was needed in their work.

The catch in 1948 of 900,000,000 pounds was valued at $80,500,000, exceeding the value for any former year by $20,000,000. In 1949 although the catch was over one billion pounds the value to the fishermen was only $73,000,000. This reduction in value was due to a general reduction in the price of fish from 1948 to 1949.

RESEARCH VESSELS

The M. V. *N.B. Scofield* was in service throughout the biennium and made the following cruises:

Date	Locality	Investigation
June 29-July 7, 1948	Off California	Albacore
July 20-September 13, 1948	To Hawaiian Islands	Tuna
October 26-November 1, 1948	Off California	Albacore, mackerel and sardine
November 5-22, 1948	Off Mexican coast	Tuna, mackerel and sardine
November 28-December 1, 1948	Off Southern California	Tuna
February 22-24, 1949	Off Southern California	Sardine
February 28-March 15, 1949	Off Southern California and Mexico	Sardine
March 28-April 14, 1949	Off Southern California and Mexico	Sardine
April 28-May 14, 1949	Off Southern California and Mexico	Sardine
June 6-30, 1949	Off Northern California	Salmon
August 8-September 9, 1949	Off Northern California	Bottom fish and salmon
September 26-November 17, 1949	Off Central and Northern California	Bottom fish
February 21-28, 1950	Off Southern California	Albacore
March 7-25, 1950	Off Southern California and Mexico	Albacore
April 8-23, 1950	Off Southern California	Albacore
May 12-June 15, 1950	Off Northern California	Salmon

The M. V. *Yellowfin* conversion was completed in September, 1949, and the vessel made the following cruises:

Date	Locality	Investigation
September 26-October 14, 1949	Off Southern California and Mexico	Mackerel and sardine
October 21-November 4, 1949	Off Central California	Sardine
November 21-23, 1949	Off Southern California	Sardine
November 28-December 9, 1949	Off Southern California	Sardine
December 19-23, 1949	Off Southern California	Sardine
January 9-19, 1950	Off Southern California	Sardine
February 20-24, 1950	Off Southern California	Sardine
February 27-March 3, 1950	Off Southern California	Sardine
March 13-24, 1950	Off Central California	Sardine
April 3-20, 1950	Off Mexico	Mackerel and sardine
May 8-24, 1950	Off Southern California	Sardine
June 6-18, 1950	Off Central California	Sardine

The investigations in the San Joaquin Delta have been greatly facilitated by the construction of the new Fish and Game research vessel, *Striper*. This vessel is owned by the Bureau of Fish Conservation and is manned by a netman and boatswain employed by the Bureau of Marine Fisheries. His time is divided about equally between the two bureaus.

The *Striper* is a 28-foot Frazer River type gill-net boat with a power reel for winding up gill nets. It is equipped with bunks and facilities for cooking. When used by Fish Conservation, most of the *Striper's*

FIGURE 14. Fish and Game boat *Striper* jointly used by the Bureau of Marine Fisheries and the Bureau of Fish Conservation for research in the Sacramento-San Joaquin Delta. *Photograph by Kramer Adams.*

time is spent working on striped bass. Marine Fisheries uses most of its share of the boat's time on salmon investigation but has done some work on crabs. The boat has been used for tow net hauls, for the dragging of small trawls and dredges, and for gill-netting to obtain striped bass and salmon for tagging. The power-operated net reel makes this last operation far easier and more efficient. The use of this power reel makes it possible for the operators to make as many as six comparatively short gill-net drifts where a crew with a hand-pulled gill net would find it possible to make no more than two long drifts. This means that the fish spend a relatively short time tangled in our nets, hence are much less weakened by being held. A net is strung out in an appropriate place and allowed to drift for whatever length of time seems most desirable, usually about an hour, and then is picked up. To pick up the net, one operator steps on a treadle in the rear of the boat. This starts the big reel turning slowly and brings in the net until a fish is reached. One man can fish with this type of boat; two men can both fish and tag if the fish are not very abundant. In the event of a heavy run of either salmon or striped bass, three men are desirable.

UNDERSEA OIL EXPLORATION

The major oil companies continued their exploration for undersea oil deposits until mid-July, 1949. By that time all of the areas in which the companies were interested had been explored by seismic methods and the commission denied applications for more work south of Point Conception prior to 1952.

The commission required that all exploratory work carried on be a joint project of all companies concerned. This prevented re-exploration by each individual company and did much to reduce the kill of fish. The Bureau of Marine Fisheries maintained an observer with each seismic crew during all operations. The cost of the observers was borne by the oil companies.

PUBLICATIONS BY STAFF MEMBERS OF THE BUREAU OF MARINE FISHERIES

Circular No. 23. Statistical Report of Fresh and Canned Fishery Products, Year 1948.

Circular No. 24. Statistical Report of Fresh and Canned Fishery Products, Year 1949.

Fish Bulletin No. 68. Common Marine Fishes of California. By Phil M. Roedel. 1948; 150 p.

Fish Bulletin No. 69. Age and Length Composition of the Sardine Catch Off the Pacific Coast of the United States and Canada, 1941-42 through 1946-47. By Frances E. Felin * and Julius B. Phillips. 1948; 122 p.

Fish Bulletin No. 70. A Preliminary Population Study of the Yellowfin Tuna and the Albacore. By H. C. Godsil. 1948; 90 p.

Fish Bulletin No. 71. Growth of the Sardine, *Sardinops caerulea*, 1941-42 through 1946-47. By Julius B. Phillips. 1948; 33 p.

Fish Bulletin No. 72. Trawling Gear in California. By W. L. Scofield. 1948; 60 p.

Fish Bulletin No. 73. Tagging Experiments on the Pacific Mackerel, *Pneumatophorus diego*. By Donald H. Fry, Jr., and Phil M. Roedel. 1949; 64 p.

Fish Bulletin No. 74. The Commercial Fish Catch of California for the Year 1947 With an Historical Review, 1916-1947. By the Staff of the Bureau of Marine Fisheries. 1949; 267 p.

Fish Bulletin No. 75. California Sharks and Rays. By Phil M. Roedel and Wm. Ellis Ripley. 1950; 88 p.

Fish Bulletin No. 76. Average Lunar Month Catch by California Sardine Fishermen, 1932-33 through 1948-49. By Frances N. Clark and Anita E. Daugherty. 1950; 28 p.

Bonnot, Paul
1948. The Abalones of California. Calif. Fish and Game, vol. 34, no. 4, p. 141-169.

Bonnot, Paul, and Wm. Ellis Ripley
1948. The California Sea Lion Census for 1947. Calif. Fish and Game, vol. 34, no. 3, p. 89-92.

Clark, Frances N.
1948. Problems Connected With the Management of the Sardine Fishery. Thirteenth North Amer. Wild. Conference, Transactions, p. 339-347.

Felin, Frances E.,* Julius B. Phillips and Anita E. Daugherty
1949. Age and Length Composition of the Sardine Catch Off the Pacific Coast of the United States and Canada in 1948-49. Calif. Fish and Game, vol. 35, no. 3, p. 165-183.

* With U. S. Fish and Wildlife Service.

Fitch, John E.
1948. Some New and Unusual Fishes From Southern California. Calif. Fish and Game, vol. 34, no. 3, p. 133-135.
Use of DUKW's in the Fishery For Basking Sharks, *Cetorhinus maximus*. Calif. Fish and Game, vol. 34, no. 4, p. 219-220.

1949. Some Unusual Occurrences of Fish on the Pacific Coast. Calif. Fish and Game, vol. 35, no. 1, p. 41-49.
The Great White Shark, *Carcharodon carcharias* (Linnaeus) in California Waters During 1948. Calif. Fish and Game, vol. 35, no. 2, p. 135-138.
Observations and Notes on Some California Marine Fishes. Calif. Fish and Game, vol. 35, no. 3, p. 155-158.

1950. Life History Notes and the Early Development of the Bonefish, *Albula vulpes* (Linnaeus). Calif. Fish and Game, vol. 36, no. 1, p. 3-6.
Notes on Some Pacific Fishes. Calif. Fish and Game, vol. 36, no. 2, p. 65-73.

Fitch, John E., and A. O. Flechsig
1949. A Brief Account of the Monterey Spanish Mackerel (*Scomberomorus concolor*). Calif. Fish and Game, vol. 35, no. 4, p. 275-280.

Fitch, John E., and Robert C. Wilson
1949. Observations on the Northern Elephant Seal, *Mirounga angustirostris*. Journal of Mammalogy, vol. 30, no. 2, p. 192-194.

Godsil, H. C.
1949. A Progress Report on the Tuna Investigations. Calif. Fish and Game, vol. 35, no. 1, p. 5-9.

Hagerman, Fred B.
1949. Large Dover Sole Taken Off Eureka. Calif. Fish and Game, vol. 35, no. 3, p. 202.
Tagged Flatfish Recovered at Eureka. Calif. Fish and Game, vol. 35, no. 4, p. 328.

1950. The Extension of the Range of the Deep Sea Flounder, *Embassichthys bathybius* (Gilbert). Calif. Fish and Game, vol. 36, no. 2, p. 165-166.

Holmberg, Edwin K.
1948. Deep Dragging by Eureka Otter Trawlers. Calif. Fish and Game, vol. 34, no. 4, p. 218-219.

McCully, Howard
1949. New Type of Field Key Applied to the Flatfishes of California. Calif. Fish and Game, vol. 35, no. 1, p. 11-13.

Mosher, Kenneth H.,* Frances E. Felin * and Julius B. Phillips
1949. Age and Length Composition of the Sardine Catch Off the Pacific Coast of the United States and Canada in 1947-48. Calif. Fish and Game, vol. 35, no. 1, p. 15-40.

Ripley, Wm. Ellis
1949. Tagging Salmon With Blowgun Darts. Copeia, no. 2, p. 97-100.

Roedel, Phil M.
1948. Pacific Mackerel in the Gulf of California. Copeia, no. 3, p. 224-225.
1949. Notes on the Spawning Grounds and Early Life History of the Pacific Mackerel. Calif. Fish and Game, vol. 35, no. 3, p. 147-153.
Movements of Pacific Mackerel as Demonstrated by Tag Recoveries. Calif. Fish and Game, vol. 35, no. 4, p. 281-291.

Scofield, W. L.
1948. Do Lobsters Shrink When Cooked? Calif. Fish and Game, vol. 34, no. 4, p. 217-218.
1950. Small Boat Stabilizers. Calif. Fish and Game, vol. 36, no. 1, p. 53-54.

* With U. S. Fish and Wildlife Service.

PACIFIC MARINE FISHERIES COMPACT

As mentioned in the Fortieth Biennial Report, the state legislatures of Washington, Oregon, and California enacted legislation authorizing the execution of the Pacific Marine Fisheries Compact during their 1947 sessions. The governors of the three states executed the compact. The Pacific Marine Fisheries Commission was organized at meetings in Portland, Oregon, in November, 1947, and January, 1948. The purposes of the compact are to promote the better utilization of fish which are of mutual concern, and to develop a joint program of protection and prevention of waste of such fisheries in all those areas of the Pacific Ocean over which the states have jurisdiction. The fishery biologists of the three states serve as the investigative body of the Marine Fisheries Commission. Since its organization, the commission has had meetings in all three states which have been attended by the fishing industry, by official representatives of the three states, by the U. S. Fish and Wildlife Service, and by unofficial representatives from Canada and Alaska. Since its organization, the Pacific Marine Fisheries Commission has:

1. Published a 64-page bulletin on history and development of the commission and coordinated plans for the management of the fisheries of the Pacific Coast.
2. Organized an interstate investigation of the ocean salmon fisheries of the Pacific Coast, including a tagging program of troll-caught salmon in the ocean and a marking program of salmon fry in the streams of the three states.
3. Recommended workable sets of laws on troll-caught salmon for the three states. These laws were passed as recommended by all three states.
4. Recommended legislation for the protection of the soupfin shark. The recommended legislation was approved by Oregon and Washington but did not pass the California Legislature. Subsequent development of artificial vitamin A and the importation of less expensive foreign liver oils have combined to eliminate the need for soupfin livers, killed the soupfin industry, and eliminated the need for any further conservation measures.
5. Inaugurated a sablefish investigation by the three states and with unofficial participation by Canadian and Alaskan investigators.
6. Helped coordinate the bottom fish studies of the three states.
7. Made numerous minor recommendations to the investigative staffs of the three states.

A great deal of benefit has resulted from these interstate meetings, from the development of mutual understanding and interchange of ideas between the biologists and the industry and among the biologists from the different states.

MARINE RESEARCH COMMITTEE

In 1947 the California Legislature created a Marine Research Committee to administer funds collected through a special tax of 50 cents per ton on all sardines landed in California. This committee comprises the

President of the Fish and Game Commission, the Executive Officer of the Fish and Game Commission, the Chief of the Bureau of Marine Fisheries, five members representing the fish processors and one representing the public at large.

The committee was organized during the biennium and functioned smoothly throughout. It helped to coordinate the sardine investigations being carried out by four agencies, California Academy of Sciences, California Division of Fish and Game, Scripps Institution of Oceanography and U. S. Fish and Wildlife Service.

Funds administered by the committee were expended to further the work of these agencies and used where most needed to supplement regular budgets. In the second fiscal year $97,500 was budgeted and the major part of this fund was expended on the various sardine research projects, with a small balance being carried over to the next year.

In addition to furthering the sardine studies both by furnishing financial aid and by helping to encourage and coordinate the work of the investigating agencies, the committee held a general meeting in San Francisco on April 13, 1950. At this time the biologists explained to the industry at large the type of work being done and the findings to date.

REPORT OF THE BUREAU OF LICENSES

As the work of this bureau consists chiefly of supervising the printing of all licenses, their distribution to approximately 3,200 agencies throughout the State, controlling the remittances and closing out the license accounts at the end of each season, and other work in connection with license distribution, there have been very few changes during the past biennium. The work is chiefly of a routine nature.

There have been a few changes in the law so that we could better control license agents in their handling of license funds, etc., and also a few changes in license fees. The nonresident hunting license fee has been changed from a $10 reciprocal basis to a straight $25 fee. The duplicate license, which previously sold for 50 cents, has been eliminated and the law now provides that all licenses or tags provided by the Fish and Game Code issued as duplicates require the payment of the original fee. The nonresident angling license fee has been changed from a $5 reciprocal basis to a $10 fee. A new nonresident angling license has been established which permits the applicant to fish for a period of 10 days from the day of issue for a fee of $3. This law has become quite popular with nonresident anglers, although the bulk of our nonresident fishing licenses are sold to the residents of Nevada, our neighboring state, and most of these persons purchase a full season license. A nonresident and alien deer tag was also established by law, the fee for which is $10. The fish packers and shellfish dealers law was amended, and now provides that only persons or firms dealing in fish on a wholesale basis are required to purchase a fishpacker's license. The old law provided that every person or firm who dealt in fresh fish was required to purchase a license. This law created a hardship on many of the fresh fish dealers and butcher shops who handled fresh fish only one or two days a week and they did not sell enough fish to warrant their taking out a license.

The principal reason for changing the nonresident fishing and hunting licenses from a reciprocal to a flat fee basis was that, although we had properly advised all of the agents as to the correct fee to be collected from applicants from the various states, they inadvertently were neglecting to collect these proper fees and invariably would charge the applicant the minimum fee, necessitating that our offices penalize the agents and require them to pay the difference between the amount that was collected and the amount provided by law. This created considerable difficulty on the part of the agent and it became very unpopular; therefore it was believed that a flat fee would be more satisfactory. The nonresident fee now charged by California for both hunting and fishing licenses is no greater than that charged nonresidents by the states of Oregon, Washington, and Nevada. Ninety-six percent of the nonresident hunting licenses were sold to residents of Nevada and Oregon. Sixty-five percent of the nonresident angling licenses were sold to residents of Nevada alone. The three bordering states—Arizona, Nevada, and Oregon—accounted for approximately 78 percent of all nonresident hunting and angling licenses.

During the biennium the Fish and Game Commission rescinded the order requiring the wearing of licenses on the outside of the clothing above the waistline when hunting and fishing. No money had been provided for the purchase of license holders so that the sportsmen could wear the license on the outside of their clothing. Many complaints were received from the license agents because we did not furnish the holders, and it had been recommended to the commission that this order be rescinded. However, many of the license agents are now purchasing the holders from the manufacturer and these agents are either selling them to the license buyers for a very small fee or are giving them away free of charge.

At the 1948 Session of the State Legislature a new law was passed providing that every person who hunted pheasants must have in addition to the regular hunting license a pheasant tag, the fee for which was $1. Due to the short time elapsing between the time that the Governor signed the bill and the opening of the pheasant season it was not possible to obtain a completely satisfactory pheasant tag, although the one procured was fairly satisfactory. The sale of the pheasant tags in 1948 was not as great as had been expected, the total sales amounting to 171,352.

During the 1948 hunting season for waterfowl the waterfowl management area regulations went into effect. This act permitted the hunters to shoot on waterfowl management areas provided by the Fish and Game Commission. There were three types of areas established: the developed area where hunters were charged $5 per shoot; partly developed areas, where the fee was $1; and undeveloped areas where no blinds were furnished and hunters were permitted to hunt free of charge. Boys under 16 years of age, when accompanied by a permittee on a developed area could hunt for $2.50. The number of permits issued is shown at the end of this report.

During the biennium we experienced very little difficulty with our license agents in requiring full settlement on all license sales, and in closing out accounts. The amended law, providing that all agents must remit on all books completely sold not later than the tenth of the following month, greatly assisted our offices in controlling these agents. Although we do have laws governing the manner in which agents must account for their license money, the fact that we have 3,200 agents scattered throughout the State and that our personnel is quite small makes it difficult to supervise all of them properly.

The premium on our deer meat permit bonds was reduced to $1 for each $500 sold, and we have in excess of 500 locker plants and cold storage plants holding deer meat after the legal time that deer meat may be possessed by the hunter.

ANTELOPE DRAWING

In 1949, the commission provided that there should be a special hunt for antelope in the northeastern part of the State and that 500 permits should be issued. The law providing for these special antelope hunts had previously been amended to provide that no person could apply for a permit who had received a permit in any one of the 10 years previous. This made it necessary that every application received in 1949 be carefully sereened—with 2,000 cards for persons to whom permits had

been issued in previous years. The drawing was held at Sacramento on July 27th. There were 7,548 applications received. Of the first 500 persons who were eligible to apply for a permit, 418 applied for and were issued permits, and 82 permits were issued to alternates—the last alternate to be issued a permit had a drawing number of 632. The number of applicants for the years in which there have been hunts were:

1942	2,811
1943	3,653
1944	3,910
1945	4,675
1949	7,548

CATALINA DEER DRAWING

A special deer hunt was provided for Santa Catalina Island, at the request of the owners who claimed that there were too many deer there. The last day to file an application was September 28, 1949. The drawing was held at Los Angeles on October 5th. There were 7,919 applications received. Permits were issued on a weekly basis; 150 permits were issued for each weekly hunt for a period of 13 weeks. There were 100 alternates drawn for each weekly group in order to complete the issuance of the full 150 permits for each week's quota. In all there were 1,950 permits issued.

ELK DRAWING

There was also a special drawing for an elk hunt in Inyo and Mono Counties in 1949. There were 15,258 applications received. The last day to file was October 26th, and the drawing was held at Los Angeles on November 2, 1949. There were 125 permits issued, 75 for bull elk and 50 for cow elk.

The following tabulation shows the value of the various types of licenses sold in recent years.

HUNTING

Year	*Value*	*Number*	*Year*	*Value*	*Number*
1938-39	$487,763.50	252,117	1944-45	$626,634.00	318,910
1939-40	528,952.00	270,095	1945-46	780,106.50	393,282
1940-41	565,395.00	291,507	1946-47	965,916.00	487,307
1941-42	643,700.00	331,878	1947-48	1,016,600.50	507,068
1942-43	522,985.00	268,128	1948-49	1,482,442.00	504,621
1943-44	557,254.00	284,370	1949-50	1,446,172.00	496,975

ANGLING

Year	*Value*	*Number*	*Year*	*Value*	*Number*
1938	$705,611.00	348,227	1944	$883,841.00	436,940
1939	746,061.00	366,452	1945	1,120,661.50	557,536
1940	791,472.00	390,342	1946	1,553,706.00	768,816
1941	933,586.00	460,715	1947	1,793,368.50	884,772
1942	876,003.00	433,431	1948	2,931,724.00	960,146
1943	899,782.00	447,352	1949	3,023,579.00	991,903

DEER TAGS

Year	Value	Number	Year	Value	Number
1938	$141,598.00		1945	$214,662.00	
1939	152,924.00		1946	282,060.00	
1940	163,285.00		1947	299,610.00	
1941	173,699.00		1948	300,384.00	
1942	116,121.00				
1943	147,795.00		1949	318,748.00	Citizen, 308,838 Non-Res. 991
1944	178,250.00				

MARKET

Year	Value	Number	Year	Value	Number
1948-49	$142,520.00	14,252	1949-50	$149,670.00	14,670

PHEASANT TAGS

Year	Value	Number
1949	$171,352.00	171,352

TRAPPING

Year	Value	Number	
1948-49	$1,272.00	Citizen	1,258
		Alien	7
			1,265
1949-50	1,176.00	Citizen	1,162
		Alien	7
			1,169

ARCHERY HUNTING

Year	Value	Number
1948-49	$1,981.00	Citizen, 652, Alien, 5—Total 657
1949-50	2,690.00	Citizen, 875, Alien, 15—Total 890

ARCHERY DEER TAGS

Year	Value	Number
1948-49	$665.00	665
1949-50	882.00	882

DEER MEAT LOCKER PERMITS

Year	Value	Number
Cold storage		
1948	$17,875.50	35,751
1949	10,311.50	20,623
Wardens		
1948	$1,241.00	1,241
1949	1,196.00	1,196

FISH DEALERS AND FISH PACKERS

Year	Value	Number	
1948-49	$16,265.00	Citizen	3,141
		Alien	28
			3,169
1949-50	2,515.00	Citizen	499
		Alien	1
			500

GAME MANAGEMENT AREAS

Year	*Value*	*Number*
1948	$470.00	47
1949	420.00	42

COMMERCIAL HUNTING CLUB

Year	*Value*	*Number*
1948-49	$700.00	28
1949-50	750.00	30

COMMERCIAL HUNTING CLUB OPERATOR

Year	*Value*	*Number*
1948-49	$230.00	46
1949-50	215.00	43

WATERFOWL MANAGEMENT AREA PERMITS

Year	*Value*		*Number*
1948-49	$2,510.00	developed	502
	643.00	partly developed	643
	45.00	junior	18
Total	$3,198.00		1,163
1949-50	$3,460.00	developed	692
	493.00	partly developed	493
	75.00	junior	30
Total	$4,028.00		1,215

REPORT OF THE BUREAU OF FISH CONSERVATION

The number of California anglers continues to grow but at a decreasing rate. In 1940 the number of licenses sold was 388,742 as compared with 960,146 in 1948 and 991,914 in 1949. It is obvious that the big surge is over for the time being but the increase is still substantial. If continued for another 10 years at the present rate the total number added will be approximately 300,000, more than the total number licensed in 1930.

In 1948 the increase in the price of an angling license from $2 to $3 brought an immediate increase of 50 percent in revenue. This change has only partially been reflected in the money made available for the work of the Bureau of Fish Conservation. In 1940 and 1948 the bureau received for expenditure about $1 for each license sold and in 1949-1950 the budget provided about $1.43 for the bureau's use in serving each angler. A similar ratio is expected for the next fiscal year. So far the Wildlife Conservation Board has in addition provided $3,800,540 for capital improvement, which is being expended over a period of years. It is obvious that the service that can be rendered to each angler for $1.50 is very limited. As will be seen from the report that follows, the work of the Bureau involves a wide range of activities.

From the angling catch estimates based on carefully handled and tested postal card surveys it appears that in 1949 there have been very few statistically significant changes in the total number of fresh-water and anadromous fish taken as compared with 1948. The numbers of various categories in 1949 are shown in Table 7.

TABLE 7. 1949 CATCHES OF LEADING SPORT FISH

	Total	Mean catch per angler
Trout	16,700,000	38.7
Striped bass	1,750,000	10.6
Black bass	1,160,000	10.0
Crappie	2,430,000	23.1
Sunfish	4,020,000	35.3
Catfish	3,930,000	24.4
Salmon	298,000	4.4

As derived from the Opinion Research Center Survey of 1949 the interest in different types of fishing is as follows on a percentage basis:

Trout and salmon	50.7 percent
Striped bass	13.0 percent
Warm-water species	16.4 percent
Marine	15.3 percent
No preference	4.6 percent

An interesting by-product of the angling catch estimates is the probable number of license buyers resident in each county. Trinity

County is high with 32 percent of the residents having licenses, based on the 1950 census.

In the 20 to 25 percent group are other mountain counties such as Siskiyou, Del Norte, Humboldt, Inyo, Plumas, Modoc, and Lassen. Most other rural counties fall in the 10 to 15 percent group. The lowest percentages of license buyers are found in the metropolitan counties of San Francisco and Los Angeles, with only 6 to 7 percent buying licenses. All in all, about 10 percent of Californians now buy licenses and this compares favorably with other populous states where fishing is a favorite recreation.

The annual production of trout has changed very little in numbers in the last few years. In 1949, 18,791,000 trout weighing 488,000 pounds were planted, which is about the total weight that can be achieved with present facilities. Of these trout 2,424,000 were of catchable size running from 4 to 10 to the pound. As was pointed out in a recent publication, although 83 percent of these larger fish are planted in the southern part of the State, the catch and the number of trout anglers is about equally divided between the two sections of the State and the total number of trout taken, both wild and planted, is about equal north and south. The new ponds and hatcheries now being constructed will greatly increase the number of catchable trout and the areas in which they can be distributed.

The number of fish rescued was considerably less than in years gone by. There are no longer great numbers of catfish and sunfish in receding waters in the Central Valleys. In part because of dry years and in part because of water control at Shasta and Friant dams there are fewer seasonal waters and fewer resulting fish to be rescued. It is very doubtful whether the rescue of these prolific species for planting in waters already carrying their capacity load was a paying proposition anyway. In Southern California the greatest amount of rescue salvage and transfer of warm-water fish is required in order to supply stock for ponds and new and transitory lakes.

REPORT OF HATCHERY OPERATIONS

With hatcheries and residential buildings suffering considerable depreciation during the previous biennium, it became apparent that a large amount of repair and new construction must be done in order to keep existing facilities in operation and to add new hatchery facilities necessary to cope with the ever-increasing number of anglers in California. It was hoped that with the enactment of the Wildlife Conservation Act in 1947 and the subsequent allocation by that board of $2,187,200 for fish hatchery projects that a sound planned hatchery expansion and rehabilitation program could be undertaken. This was only partly the case, mainly because the Division of Fish and Game does not have its own engineering staff and must rely upon the Department of Public Works, Division of Architecture, for its engineering services. When request was first made to the Division of Architecture for engineering assistance it was found that the division was completely occupied with work for other state agencies having a higher priority. It was not until the middle of 1950 that the Division of Architecture could undertake our first fish hatchery projects.

Fish hatcheries operated during the period covered by this report are as follows:

El Dorado County

Mt. Tallac Hatchery near Camp Richardson (seasonal). 52 troughs, 16 tanks 4′ x 16′ x 30″.

Fresno County

Huntington Lake Hatchery near Lakeshore (seasonal). 6 tanks, 16′ long; three are standard width of 4′ and three are less than 4′ in width.

Kings River Hatchery, 56 miles east of Fresno. 100 troughs, no tanks or ponds.

Humboldt County

Prairie Creek Hatchery near Orick. 80 troughs, five redwood tanks, 4′ x 16′ x 30″, located outside of hatchery building.

Inyo County

Mt. Whitney Hatchery and Black Rock rearing ponds near Independence. 120 troughs, two circular ponds, and three rectangular ponds at hatchery, used largely for spring spawning rainbow brood stock. Two large rearing ponds and one brood stock pond are maintained at Black Rock Springs.

Kern County

Kern Hatchery near Kernville. 20 troughs, six round redwood tanks 14′ in diameter, 30″ deep. Eight concrete ponds, 80′ x 12′ x 36″, 13 earth raceways.

Lassen County

Lake Almanor Hatchery near Westwood. 96 troughs, eight redwood tanks, 4′ x 16′ x 30″, located in hatchery building, and three cement ponds approximately 8′ x 30′ x 30″.

Los Angeles County

Whittier Hatchery. Six ponds, 100′ x 12′.

Madera County

Madera Hatchery near Bass Lake. Six troughs, 10 tanks, 16′ x 4′ x 30″.

Mariposa County

Yosemite Hatchery in Yosemite National Park. 52 troughs, six circular ponds.

Mono County

Hot Creek Hatchery near Bishop. 64 troughs, 35 rearing ponds, two brood stock ponds.

Napa County

East Side rearing reservoir in Napa. Placed in operation October, 1948.

Placer County

Tahoe Hatchery near Tahoe City. 64 troughs, no ponds or tanks.

Plumas County

Feather River Hatchery near Clio. 60 troughs, four circular ponds, 20′ in diameter, concrete construction.

Sacramento County

Central Valleys Hatchery near Elk Grove. 21 bass ponds, 19 daphnia tanks. Devoted to the rearing of warm-water fish during the spring and summer months, and trout during the fall and winter.

San Bernardino County

Mojave River Hatchery near Victorville. 20 ponds. First four ponds placed in operation June, 1947. Construction of 16 additional ponds started May, 1950.

Santa Cruz County

Brookdale Hatchery near Brookdale. 40 troughs, six circular concrete ponds 16′ in diameter with an average depth of about 16″. One rectangular pond, concrete construction, approximately 35′ long, 12′ wide, average depth about 16″.

Shasta County

Burney Creek Hatchery near Burney. 100 troughs, no ponds.

Crystal Lake Hatchery. 24 ponds constructed and put in operation October, 1947.

Darrah Springs Hatchery near Paynes Creek. Five ponds. First operated July, 1949.

Sierra County

Yuba River Hatchery near Camptonville. 30 troughs. There are no ponds or tanks at this hatchery.

Siskiyou County

Fall Creek Hatchery near Copco. 116 troughs, nine ponds. Last operated 1948. Officially closed December, 1949.

Mt. Shasta Hatchery near Mt. Shasta City. 248 troughs. Construction of 16 raceway type ponds started in May, 1950. Plans have been made for adding a new feed room and hatchery building having 120 troughs.

Tulare County

Moorehouse Spring Hatchery near Springville. Six redwood tanks 14′ in diameter, 30″ deep. 18 natural earth-fill ponds. Put in operation June, 1947.

Kaweah Hatchery near Three Rivers. 60 troughs, no tanks or ponds.

Sequoia Hatchery near Visalia. 10 14′ round redwood tanks, 30″ deep. One rectangular pond approximately 8′ x 200′.

Tuolumne County

Basin Creek Hatchery near Tuolumne. 80 troughs, nine tanks 16′ long, 4′ wide, 30″ in depth.

Ventura County

Fillmore Hatchery near Fillmore. Eight troughs, six circular tanks, 30 rearing ponds.

HATCHERY ADDITIONS AND BETTERMENTS

Darrah Springs Hatchery, Shasta County. Experimental operations started July, 1949. Operations have been very satisfactory and five earth-fill ponds constructed. Plans have been made to purchase the hatchery site presently under lease and it is expected this location will eventually be developed into one of the largest hatcheries in the State. A constant water supply of approximately 30 c.f.s. at temperatures ranging from 56 degrees to 60 degrees makes this site especially adaptable to the production of eggs and the rearing of catchable-size trout.

Moorehouse Spring Hatchery, Tulare County. Experimental operations started 1947. A spring-fed water supply of approximately 60 degrees, while limited in volume, makes this station adaptable to the rearing of trout. During the biennium two dwelling houses, a four-stall garage and a refrigerated food preparation room were built and other minor improvements were made.

Mojave River Hatchery, San Bernardino County. Experimental operations, consisting of four rearing ponds, were started at this location in June, 1947. The number of ponds was increased to 20. This work was started by the contractor in May, 1950, and nearly completed at the end of the biennium. Two new electrically operated pumps with auxiliary gasoline engines were installed.

Mt. Shasta Hatchery, Shasta County. Rehabilitation of this hatchery, which has been in constant operation since 1888, was undertaken during the latter part of the period covered by this report. This consisted of removing nearly the entire outmoded pond system and installing 16 earth-fill raceway type ponds. A contract covering this pond construction in the amount of $68,402 was let on July 18, 1950. Additional plans for installing a new feed room and a hatchery building with 120 troughs have been completed. Funds for this project were provided by the Wildlife Conservation Board.

Mt. Whitney Hatchery, Inyo County. Additions to this hatchery consisted of a new feed room with 60,000-pound capacity refrigerator, three new dwelling units and extensive repairs to ponds and water supply system.

Black Rock Rearing Ponds, Inyo County. A long term lease on this rearing pond site was obtained from the City of Los Angeles on May 20, 1949. Improvements consisted of two four-room dwelling houses with pressure system water supply and electric distribution system. Additional improvements, consisting mainly of a by-pass ditch which will facilitate operations, will be undertaken early during the coming biennium.

Kern Hatchery, Kern County. Expansion and improvement of the Kern Hatchery was carried on throughout nearly the entire two-year period. The work was accomplished with Wildlife Conservation Board funds under the direction of hatchery personnel. It consisted mainly of building two new dwelling units, an extension to the hatchery building, and a new feed room with refrigeration facilities, and improving the water distribution system.

Fillmore Hatchery, Ventura County. The water supply at this hatchery failed entirely when the Santa Clara River went dry in September, 1948. In order to continue operations, it was necessary to drill two wells—one in January, 1948, and the other in June, 1949. Other improvements included four new houses, a garage and new hatchery building.

Hot Creek Hatchery, Mono County. This hatchery is not served by a public utility, and electricity for lighting and food preparation was until recently provided by several small butane-operated Kohler lighting plants. These units were discontinued in 1949 when a 30 k.v.a. Diesel generator was installed. The hatchery building, containing 30 troughs and formerly located in Alpine County, was moved to this location to provide additional incubating and rearing facilities.

Yosemite Hatchery, Mariposa County. Improvements at the Yosemite Hatchery consisted of removing the old deteriorated wood floor and replacing it with one of reinforced concrete. A new feed room and six circular ponds were constructed, a new roof was placed on the hatchery building, and improvements were made in the bachelor quarters.

EXPERIMENTAL HATCHERIES

In order to test the suitability of the water for fish rearing purposes before a permanent installation is made at proposed hatchery sites, the following experimental hatcheries were operated:

Moccasin Creek, Tuolumne County. Experiment started December, 1949. Indications are the water supply is satisfactory and a lease for use of the property is being negotiated with the City of San Francisco, Department of Water and Power. Preliminary plans for a complete hatchery unit are being prepared by the Division of Architecture.

Willow Creek, Lassen County. Fish rearing experiment at this station got under way in June, 1949, and the experiment was discontinued in December, 1949. The high alkalinity of the water at this location, where temperatures were favorable, made fish rearing activities impossible. The site has been permanently abandoned.

Cedar Creek, Mendocino County. Experiment started July, 1949, but interrupted when heavy storms damaged the installation in January, 1950. Sufficient experimenting was done before interruption, however, to indicate that the water supply is suitable.

Tule River, Tulare County. Experiment started June, 1950, and being continued at the close of the biennium. Indications are this water supply is probably unsuitable for fish rearing purposes.

HATCHERIES CLOSED

Alpine Hatchery near Markleeville, Alpine County. Last operated 1941. Hatchery abandoned and buildings dismantled and moved to Hot Creek, September, 1949.

Fall Creek Hatchery near Copco, Siskiyou County. One hundred sixteen troughs, nine ponds. Last operated 1948. Officially closed December, 1949. Buildings are in poor condition but station is being kept intact pending further studies of the salmon and steelhead situation in the Klamath River.

Burney Creek Hatchery near Burney, Shasta County. One hundred troughs, no ponds. Last operated September, 1949. Poor condition of hatchery building does not permit further use. Living quarters remain occupied by personnel assigned to Crystal Lake Hatchery.

FISH PLANTING

Increased hatchery production and the rearing of larger fish has created problems in fish distribution which were satisfactorily met by developing fish planting equipment, consisting of specially constructed

FIGURE 15. Planting trout by airplane has been found to be a safe and satisfactory method of stocking lakes in remote areas. It is more economical and takes much less time than planting by means of pack stock. *Photograph by Kramer Adams.*

tanks of standard manufacture and employing an improved type aerating system, utilizing the Venturi type aspirator. Long range transportation of catchable fish with these new units is now possible. The stocking of remotely located lakes in the high mountainous areas of California has for many years presented a difficult task, since this was always done by man and pack animal. Early in 1947 the Bureau experimented with planting fish by airplane. Experiments were continued during 1948.

FIGURE 16. Loading trout for stocking. The pickup truck is equipped with a recently developed 150-gallon aerated planting tank. *Photograph by Kramer Adams.*

The use of a C-45 Beechcraft plane in aerial trout planting was started in 1949 and greatly expanded in 1950. The plane is equipped with a tank with a trip valve seated in the aerial camera port. Fish are transported in 12 light aluminum cans and the plants for each lake, of which three to five may be covered in a single trip, are loaded into the larger tank successively. The crew consists of two pilots and a planter in the cabin.

All checks so far made both from the air and on the ground indicate almost complete success. Two barren lakes planted in 1949 were checked in 1950 and very good survival was apparent. In 1950 a total of 426 lakes from Siskiyou to Inyo County was planted with 1,633,275 trout. The cost for the use of the plane was $2,477.50—less than was sometimes paid to one packer in previous years.

Tables showing the total numbers of fish reared and planted in each county and obtained through rescue work will be found in Appendix D.

It has been found necessary to change the period of accounting for hatchery production from the calendar year to the fiscal year in order

to make satisfactory cost analyses. Figures on costs of operation are only available to the bureau on a fiscal year basis. Although this causes a break in the middle of the peak of the planting season it was deemed advisable to make the change by taking an inventory of fish on hand as of July 1st in order to relate the production to cost of operation. Two of the tables given therefore cover the calendar years 1948 and 1949 and a third covers the period January 1 to June 30, 1950.

REPORT OF THE ACTIVITIES OF THE BIOLOGICAL STAFF

The preceding biennium, that of 1946-48, had witnessed the organization of the biological and pollution control work of the Bureau of Fish Conservation into essentially its present form. During that period the division of the State into eight administrative districts had been completed, with a biologist in charge of all fresh-water fisheries investigations and an assistant hatchery supervisor in charge of all hatchery activities in each district. Many major and minor projects which had been put aside because of the severe limitations on both manpower and materials imposed by World War II were initiated or reactivated.

With the basic organization completed, the activities of the biological and pollution control staff were accelerated all along the line during the 1948-50 Biennium to meet the tremendous problems arising in the postwar period and at the same time to take advantage of the large sums of money made available for capital expenditures through the California Wildlife Conservation Act. These problems arise from two main sources: (1) Fishing pressures on angling waters resulting from a phenomenal rise in the numbers of anglers, and (2) removal of fishing waters for power, irrigation, domestic, and flood control purposes.

In the postwar period the biological staff has faced a series of new kinds of problems which had to be met with new techniques and methods and in large part by personnel with little actual field experience. It is inevitable that under these circumstances considerable time was first devoted to an acquaintance with conditions by new personnel and to basic fact-finding. Of course, new problems continue to arise and additional fact-finding will be necessary to meet these new problems and also to understand better the old ones, but already it has been possible to make major recommendations regarding both immediate and long-range problems and to start carrying out these recommendations.

As the members of the biological staff have become acquainted with the problems in their respective districts they have been assigned an increasing share of administrative responsibility, so that in most areas they are now in charge of not only investigative work but also such phases of applied fisheries management as fish rescue, stream and lake improvement, and screening of water diversions.

Obviously, it would be physically impossible for the two to three permanent members of the biological staff in each district to carry out by themselves the necessary field surveys of streams and lakes and other fact-finding phases of the work, to study and analyze and report on their own field investigations and those of other agencies (e.g., the voluminous data presented for comment and recommendations by federal agencies

engaged in large-scale dam construction), to answer the numerous inquiries which are addressed to them, to plan and carry out applied fisheries management, and to carry out various purely administrative duties.

Rather than attempting to enlarge appreciably the personnel of the permanent biological staff to meet this work load, it has been deemed best to furnish other help as needed. This help has come from two sources: (1) permanent employees from the hatchery staff, who carry out mainly such fact-finding work as counting spawning runs of salmon and steelhead and such applied management work as fish rescue, stream and lake improvement, and screening of diversions, and (2) temporary employees consisting of Fish and Game Seasonal Aids and Student Biologists. Student Biologists are used to assist the permanent staff members in conducting stream and lake surveys and other routine field and laboratory investigations and in the case of well-qualified men occasionally also to carry out certain fact-finding projects more or less independently. Seasonal aids are used as needed in various phases of both the investigative and applied phases of fisheries management.

During the biennium the biological staff was increased from 15 full-time employees to 23. The publications and administrative reports listed at the end of this report indicate by their titles and by accompanying abstracts some of the work of the staff; further description follows.

STREAM AND LAKE SURVEYS

Biological surveys of our streams and lakes may be termed an inventory of the waters of California carried out to secure the information necessary for their proper management. Such surveys are a continuing function of the biological staff and form the backbone of the long-range program. In general, they are carried out as other duties permit, but during the biennium intensive surveys were made in some areas, notably the following:

Siskiyou County. The survey of the high mountain lakes of the Marble Mountain Wilderness Area, started in 1947, was completed during the summer of 1949. In all, 79 lakes that have possibilities of providing trout fishing were surveyed.

Trinity County. The survey of the lakes of the Trinity Alps Wilderness Area was begun during the summer of 1950.

Lassen County. During part of the summer a survey was made of the many small lakes in the Caribou Primitive Area and recommendations for management submitted for 36 of them.

District 3. Surveys were made of 92 lakes and 42 streams during the biennium.

District 6. In addition to checks on previously surveyed waters, new surveys were made of 127 lakes and 20 streams.

District 7. During the biennium 134 lakes and 20 streams in Mono and Inyo Counties were surveyed.

District 8. Detailed surveys were made of approximately 75 waters.

STUDIES ON SPECIAL WATERS

In addition to the foregoing surveys to provide general information, special studies were carried out on the following waters, not including Wildlife Conservation Board Projects, which are discussed in a special section of this report:

Castle Lake, Siskiyou County. The program at Castle Lake is designed to find out what species of trout should be planted in similar lakes, and to study the costs of planting various species and sizes in terms of yield to the angler.

Sacramento River Test Stream, Siskiyou County. The present objective of this investigation is to determine the effectiveness of planting fingerling trout in similar streams. Marked hatchery trout are planted and the returns checked by creel census and electric shocking. Results to date show that a very small percentage of planted fingerlings reach a length of six inches.

Klamath River Investigation, Siskiyou County. This program consists of a long-range study of the factors affecting the survival of salmonids in the Klamath River system. One year is being devoted to the study of each principal supposed factor.

Eagle Lake, Lassen County. This study was initiated to find ways to prevent the extinction of the Eagle Lake trout and to restore trout fishing.

Lake Almanor, Plumas County. The study of this lake was started in 1941 to determine causes for the reported poor trout production and to measure the yield to the angler from plants of hatchery-reared fingerling trout. The study was discontinued during the war, before any results could be obtained, but was resumed in 1946 with the planting of marked trout fingerlings. Catch data are now being analyzed.

Lake Tahoe Fishery Survey, Placer and El Dorado Counties. Field studies were conducted on Lake Tahoe during the summer seasons of 1948 and 1949 by a college graduate student employed as a Student Biologist, in partial fulfillment of his requirements toward a Ph.D. degree. This work included studies of the food and habits of the various species of fishes present and of their physical environment.

Echo Lakes, El Dorado County. The very low trout catch despite heavy stocking in these lakes has been the subject of a continuing investigation by the personnel of District 3. Early in the biennium, limnological and population studies were conducted and in the fall of 1949 a fish trap was constructed in the outlet. Marked rainbow trout have been planted and it is hoped that recoveries of both marked and unmarked fish in the trap will yield valuable information on losses through the outlet.

Clear Lake, Lake County. A detailed study of the fishes and fishery of Clear Lake was completed during the biennium. This work resulted in definitive reports on the food of young black bass and on the life histories of the greaser blackfish, Sacramento perch, hitch, and Sacramento squawfish. Of immediate interest was an intensive study of the possible value of a closed season on warmwater fishes. This study was done largely at Clear Lake, but drew upon data from other waters. The study concluded that there was no management value in a closed season. The Clear Lake investigation also led to the conclusion that the game fish population could be increased if the forage fish supply was augmented. The golden shiner was selected for introduction and a rearing pond was constructed and stocked with shiners from San Diego County. A detailed study of the effect of TDE on fish life and other aquatic organisms led to recommendations that insured a minimum loss to sport fishing when Clear Lake was treated with this chemical in 1949 to eliminate the Clear Lake gnat.

Millerton Lake, Fresno/Madera Counties. An intensive study of the Millerton Lake warm-water fishery, as a typical example of the large fluctuating reservoirs along the west slope of the Sierra Nevada, was started in 1949. Present evidence indicates a lack of forage fish to be the main factor limiting the fishery. At the request of sportsmen, and in an attempt to improve the deficiency of food for bass, a submpoundment in which to raise bluegill fingerlings was tried, but without appreciable success.

Rush Creek Test Stream, Mono County. Operation of this project was continued through the biennium. Results demonstrate a high survival (80 percent or more) to the creel from in-season plants of catchable rainbow and a low survival (less than 10 percent) from fall plants of rainbow fingerlings.

Rock Creek Stream Use Census, Mono and Inyo Counties. A stream-use survey and creel check was carried out on portions of Rock Creek throughout the fishing season of 1948, in order to obtain facts to support a protest by the Division of Fish and Game against the diversion of Rock Creek above Tom's Place. Information obtained indicated a total stream use of 29,548 angler days and an average use of 25.4 anglers per day for each mile of stream.

Owens River Development Project, Mono and Inyo Counties. Investigations into the possibilities for further fishery development of the Owens River were begun in May, 1949, and have been continued through the biennium. Findings to date indicate that this 150-mile long stream could receive much heavier utilization.

Colorado River Program. Preliminary meetings with representatives from Arizona were held during the latter part of the biennium and resulted in the establishment of a joint fisheries study program in June, 1950, with one man from each state assigned to the program.

Salton Sea, Imperial County. An investigation of the commercial mullet fishery was continued through the biennium. A program for the introduction of game fish and the necessary forage fish to support them was outlined and effectuated, with three introductions of forage fish and an introduction of game fish from Mexican waters; the latter was made jointly with the Bureau of Marine Fisheries.

STATE-WIDE ANGLING SURVEYS

A very intensive double survey of 1948 angling was made. It consisted of the usual postal card survey and an additional personal interview survey. Results showed conclusively that nonresponse to postal card questionnaires in the routine annual postal card survey was not a source of major error, which placed these surveys on a much firmer foundation. A restricted postal card survey of 1949 angling was made to maintain continuity in state-wide catch and angling trends. Results of these two surveys have been published in *California Fish and Game.*

CREEL CENSUSES

Creel censuses are a common method of finding out the results being obtained by stocking, of measuring the trends in the quality of angling in a given water, and of obtaining similar information useful in laying out management policies. During the biennium, principal creel censuses were carried out on the following waters:

Name of water	*County*
Klamath River	Siskiyou County
Shasta River	Siskiyou County
Shasta Lake	Shasta County
Lake Almanor	Plumas County
Truckee River	Nevada County
Upper Truckee River	El Dorado County
Donner Lake	Nevada County
Bowman Lake Area	Nevada County
Lake Pillsbury	Lake County
Conn Valley Reservoir	Napa County
Millerton Lake	Fresno and Madera Counties
Rock Creek	Inyo and Mono Counties
Crowley Lake	Mono County
Upper Rush Creek	Mono County
Hume Lake	Fresno County
Sequoia Lake	Fresno County

TEST WATERS

Although much useful information can be obtained from creel censuses of the type previously described, it is usually difficult to contact all anglers throughout the season and so obtain information on total yields from different lots of planted fish. Such information must be obtained at "test" waters: streams and lakes where studies can be made under controlled conditions.

The major test lake studied during the biennium was Castle Lake in Siskiyou County. A summary of results obtained there and at other lakes in California will be published in a forthcoming issue of *California Fish and Game*.

Studies at Rush Creek Test Stream in Mono County and Sacramento River Test Stream in Siskiyou County, initiated in 1947 and 1948, respectively, were continued during the biennium.

STREAM AND LAKE IMPROVEMENT

FISH SCREENS

The stream improvement headquarters at Yreka, Siskiyou County, continued as the center of fish screen activities conducted by the Bureau of Fish Conservation. This has been supplemented by a small screen maintenance shop in Weaverville, to service installations in Trinity County.

The Yreka shop installed screens mainly in the Klamath and Trinity drainages, but also constructed a few screens for use in other parts of the State.

Perhaps the outstanding achievement of the Yreka shop has been the creation and development of a new type of fish screen known as the "perforated plate screen." This type of screen is fully described in an article in the October, 1950, issue of *California Fish and Game*. It has now been thoroughly tested and is widely recognized as the best type which has ever been devised for irrigation diversions. Screens of this type are now being installed in all diversions in Bureau of Fish Conservation District 1.

An office building for use by the fish screen foreman and the local biologist was constructed at the Yreka headquarters during the biennium.

FISHWAYS

Existing fishways in District 1 were maintained by personnel from the Yreka headquarters and the Weaverville shop, and plans were drawn for three new fishways which will be constructed in the near future. Tests were made of fishway models of a new type, which may be useful at certain obstructions. Repairs and minor alterations were also made to a few fishways by other personnel of the Bureau.

BARRIER REMOVAL

The removal of abandoned dams to permit salmon and steelhead to reach important spawning areas has progressed very satisfactorily in tributaries of the Klamath and Trinity Rivers, with five dams removed during the biennium. In addition, two log jam barriers were removed from these tributaries.

The stream clearance program of the Bureau of Fish Conservation, which in the main previously had been confined to District 1, was expanded considerably during the biennium. A general stream clearance program was started in the northern part of District 5 during the summer of 1950 and the crew doing this work is being equipped with equipment as rapidly as funds permit. The most important project of this crew during its first season consisted of the removal of the dam on the Elk River at Falk, Humboldt County. This dam was built in 1883 and some of the logs were four feet in diameter and 25 feet long. In the entire State, seven dams were removed, 11 barriers were reduced, and seven log jams were removed during the biennium.

IMPROVEMENT DEVICES

Structures such as deflectors in streams and brush shelters in lakes have not been generally built in California, since considerable doubt has existed that such devices produce economically justifiable results. However, some counties appropriated funds from their share of fish and game fine moneys for stream improvement and our personnel cooperated with sportsmen's groups and other local interests in designing, installing, and testing small rock and masonry dams in streams with low summer flows. For example, a series of 57 such dams was built in Holy Jim Creek, Orange County, principally to create pool areas. Advice was also furnished to the Corps of Engineers, Department of the Army, regarding utilization of existing trees to create brush shelters in proposed large reservoirs.

AQUATIC WEED CONTROL

Aquatic weeds do not form a problem in the great majority of California fishing waters. However, members of the biological staff were called upon for advice and assistance in a number of troublesome instances, especially in Southern California. At Twin Lakes near Mammoth, Mono County, personnel of District 7 applied 900 pounds of sodium arsenite to dense plant masses choking areas which were untreated in the initial control work during the fall of 1947.

WILDLIFE CONSERVATION BOARD STREAM AND LAKE IMPROVEMENT PROJECTS

In addition to the work described above, some stream and lake improvement was initiated or completed with funds allocated by the Wildlife Conservation Board, including two barrier dams and two flow maintenance dams at the outlets of lakes. For further information, refer to the section on Wildlife Conservation Board Projects.

CHEMICAL TREATMENT AND REHABILITATION OF LAKES

During the biennium approximately 1,755 acres in total lake area and over 70 miles of tributary streams were chemically treated to eliminate rough fish which had so overrun these waters that sport fishing was practically destroyed in them and were then restocked with game fish. Some of the waters treated were reservoirs which had been drawn down far below their maximum and normal levels, so in effect a much

greater amount of water was rehabilitated. The following waters were treated:

Name of water	County	Surface area in acres	Date
Little Medicine Lake	Siskiyou	3.6	July 25, 30, 1948
Little Catfish Lake	Nevada	7	Aug. 21, 1948
Catfish Lake	Nevada	5 (est.)	Aug. 29, 1948
Lola Montez Lakes	Nevada	12	Sept. 9-10, 1948
Morris Lake	Plumas	40	Oct. 16-17, 1948
Jenks Lake	San Bernardino	20*	Nov. 1948
Bon Tempe Reservoir	Marin	2	Nov. 8, 1948
San Gabriel Reservoir	Los Angeles	21	Nov. 9, 1948
Jackson Lake	Los Angeles	7.5	Nov. 23-24, 1948
Lake Hinman	Napa	1.5	July 1, 1949
Crystal Lake	Shasta	37.4	July 12-15, 1949
Richardson Lake	El Dorado	12	Aug. 20, 1949
Miller Lake	Placer	24.2	Aug. 21, 1949
Upper Twin Lake	Mono	233	Sept. 12, 1949
Tamarack Lake	Mono	18	Sept. 21-23, 1949
Blue Lake	Lassen	175	Oct. 1949
Lakes Merced	San Francisco	375	Oct. 18-22, 1949
Dollar Lake	San Bernardino	1.2	Nov. 2, 1949
Bridgeport Reservoir	Mono	600	Nov. 7-9, 1949
Lake Elizabeth	Los Angeles	90	Nov. 25-26, 1949
Lake Hughes	Los Angeles	50	Nov. 25-26, 1949
Lake Munz	Los Angeles	20	Nov. 25-26, 1949
		1,755.4	

* One-fourth acre-foot when treated.

Rock masonry barrier dams were constructed on the outlet streams of Richardson and Miller Lakes, to prevent re-entry of rough fish into the lakes.

FISH RESCUE

The rescue of game fish from drying waters and their transfer to safe waters is carried on each year throughout the State. In some areas such work is needed only occasionally, as when a reservoir is drained for repair or examination of the outlet structure at the dam. Unusual or isolated cases of this sort are assigned to crews recruited from one of the hatcheries, or are taken care of by state wardens or sportsmen in cooperation with the Bureau of Fish Conservation. In other areas, however, large-scale fish rescue is required annually and forms a regular part of the program of the Bureau. This is true in some of the steelhead and salmon waters, and here this work has been placed under the supervision of the biological staff. The fish rescued are tabulated in Appendix D.

FISH INTRODUCTIONS

If an existing fishery is not producing results commensurate with expectations, there frequently arises a great hue and cry for the introduction of some exotic species. Some sad experiences resulting from such introductions many years ago have taught us to exercise extreme caution in making any new ones. It is therefore the policy of the Bureau of Fish Conservation to seek first other means of producing satisfactory angling and to introduce a new kind of fish into a body of water only if the facts indicate that it will fill a previously unoccupied niche in the economy

of that water. In several studies all available evidence has indicated that addition of a species would improve angling, and during the biennium the following important introductions were made:

Largemouth black bass into Shasta Lake, Shasta County, to provide a suitable warm-water game fish (April, 1949). These fish are now spawning in the lake, growing satisfactorily, and already producing some fishing.

Kamloops rainbow trout into Shasta Lake, Shasta County, carried out by the local sportsmen with the aid of the U. S. Fish and Wildlife Service and the California Division of Fish and Game; the sportsmen believed that this subspecies of rainbow would grow faster and be a better game fish than the native rainbows.

Kokanee red salmon into Lake Tahoe, Placer and El Dorado Counties, to provide forage for the lake trout (mackinaw) (1949 and 1950).

Greaser blackfish into East Park Reservoir, Colusa County, to provide forage for the warm-water game fishes present.

Five lakes of the Hooper Creek drainage, Fresno County, were planted with wild, adult golden trout obtained from the adjacent Bear Creek drainage. This plant was made at the expense of the Southern California Edison Company as part of its special use permit to divert Hooper Creek.

WATER USE PROJECTS

The continued rapid expansion of activity in the hydroelectric, irrigation storage, and flood control fields by governmental agencies and corporations in California has provided the fishery interests with a host of problems. With water as vital as it is to the economy of the State, it is small wonder that the agencies constructing major dams and reservoirs have been reluctant to look with favor on the release or reservation of water for fish and fishing. However, during the biennium encouraging progress has been made toward the recognition of fisheries interests in the utilization of water. For example, a release of a minimum flow of 20 second-feet of water was secured below a new dam on the San Joaquin River, whereas the release below an old dam just 11 miles upstream is only 3 second-feet. In most recent projects the protection of fish life has been included as an integral part of the planning, instead of being thrown in as an afterthought, as was so often the case in the past.

Some of the major developments which have received study by the biological staff and for which we have submitted recommendations for fishery protection during the biennium are the following:

Klamath River, Siskiyou County. California-Oregon Power Company. Hydroelectric power production causing fluctuation of river level and subsequent stranding of salmonid fishes.

Trinity River, Trinity County. U. S. Bureau of Reclamation. Proposed dams at Fairview and Lewiston for diversion of water to Sacramento River. Such diversion would greatly affect salmonid fishes below.

Feather River, Butte County. Oroville (or Bidwell Bar) Dam site. Hydroelectric and irrigation water storage dam with powerhouse and canals. Will affect sections of the North, Middle, and South Forks of the Feather River and will cut off considerable salmon and steelhead spawning grounds.

Feather River, North Fork, Plumas County. Pacific Gas and Electric Company. Cresta and Rock Creek hydroelectric power dams and tunnels, affecting sections of the North Fork of the Feather River.

Feather River, South Fork, Butte County. Oroville-Wyandotte Diversion Dam. Barrier to salmon and steelhead. Recommendations made for ladder.

Feather River, South Fork, Plumas County. Wyandotte Irrigation District. Hydroelectric power and irrigation project involving two dams (at Little Grass Valley and above present Lost Creek Reservoir) with storage capacity of 120,000 acre feet with accompanying conduits and powerhouses.

Lake Almanor, Plumas County. Pacific Gas and Electric Company. Dam forming Lake Almanor, a storage reservoir on the North Fork of the Feather River. The company plans to raise this reservoir to an elevation of 4,500 feet if conditions are found to be safe. Exploration drilling at the dam now in progress.

Sacramento River Canals, Tehama, Glenn and Butte Counties. U. S. Bureau of Reclamation. Irrigation project with power and pumping features. A study of the possibility of utilizing about 120 miles of proposed canals diverting water from the Sacramento River for productive trout water open to public fishing is being conducted in cooperation with the Bureau of Reclamation and the U. S. Fish and Wildlife Service.

Sacramento River, Tehama County. U. S. Corps of Engineers. Storage reservoir at Iron Canyon.

Keswick Dam, Shasta County. U. S. Bureau of Reclamation. Fluctuation control dam for Shasta Dam. This problem is complicated by copper pollution.

Silver Creek, El Dorado County. U. S. Bureau of Reclamation. Union Valley dam, Ice House Diversion dam, several power houses and minor diversion dams which would affect South Fork Silver, Big Silver, and main Silver creeks have been proposed.

Middle Fork Stanislaus River, Tuolumne County. South San Joaquin and Oakdale Irrigation Districts. Hydroelectric power and irrigation projects involving large dams and reservoirs at Beardsley and Donnells Flats, with accompanying conduits and powerhouses, which would affect sections of the Middle Fork Stanislaus River.

Park Creek, El Dorado County. U. S. Bureau of Reclamation. Proposed Sly Park Reservoir and Camp Creek diversion for irrigation and domestic water supplies.

North Fork Stanislaus River, Tuolumne County. Pacific Gas and Electric Company. Involving Federal Power Commission licensing of existing dams at Lake Alpine, Union, Utica, and Hunters Reservoirs for hydroelectric power purposes.

Cache Creek and Clear Lake, Lake County. U. S. Army, Corps of Engineers. Dams on Kelsey Creek, Cache Creek, and North Fork Cache Creek for flood control and irrigation. Will affect creeks named and Clear Lake.

Middle Fork Eel River, Mendocino County. G. L. Carrico. Hydroelectric and irrigation project involving large dams on the Middle Fork Eel River, a tributary of the North Fork Eel River, and a tributary of the Middle Fork Eel River, with accompanying conduits. Would affect sections of the Middle Fork Eel River and tributaries of the Middle and North Forks.

South Fork Eel River, Mendocino County. U. S. Army, Corps of Engineers. Flood control and summer flow maintenance dam. Would affect South Fork Eel River and Eel River.

San Joaquin River, Fresno/Madera Counties. Southern California Edison Company. Hydroelectric power project involving a large dam (No. 7) and reservoir above the mouth of Willow Creek, with accompanying conduit and powerhouse (No. 4), which would affect 11 miles of the San Joaquin River.

Big Dry Creek, Fresno County. U. S. Army, Corps of Engineers. The Big Dry Creek flood control project involves a dam, dikes and reservoir for which a permanent pool for warm-water fish was recommended.

Mono Creek, Fresno County. Southern California Edison Company. Hydroelectric power project involving a large dam and reservoir at Vermilion Valley, which would affect most of the easily accessible section of Mono Creek.

Kings River, Fresno County. U. S. Army, Corps of Engineers. The Pine Flat multiple purpose project, predominantly flood control, involves a large dam and reservoir at Pine Flat which will affect directly the lower portion of the Kings River, but which through re-regulation of discharge permits hydroelectric development upstream and thus indirectly will affect the entire Kings River drainage.

Kings River, North Fork, Fresno County. Pacific Gas and Electric Company or Fresno Irrigation District or U. S. Bureau of Reclamation. Hydroelectric power projects involving large dams and reservoirs at Coolidge Meadow and Sand Meadows (Helm Creek), with accompanying conduits and powerhouses which would affect the entire North Fork Kings River and many of its tributaries.

Kings River and Middle and South Forks, Fresno County. City of Los Angeles or U. S. Bureau of Reclamation or Francis X. Dlouhy. Hydroelectric power projects involving large dams and reservoirs at various sites including: Paradise Valley, Zumwalt Meadows (Sentinel site), and Cedar Grove on the South Fork; Simpson Meadow and Tehipite Valley on the Middle Fork; and at the junction of the Middle and South Forks. The dams and reservoirs, together with accompanying conduits and reservoirs, would affect the major sections of the Kings River and its Middle and South Forks.

Kaweah River, Tulare County. U. S. Army, Corps of Engineers. The Terminus flood control and irrigation benefit project, involving a large dam and reservoir which would affect the lower section of the Kaweah River.

Tule River, Tulare County. U. S. Army, Corps of Engineers. The Success flood control and irrigation benefit project, consisting of a large dam and reservoir which would affect the lowermost section of the Tule River.

Kern River, Kern County. U. S. Army, Corps of Engineers. The Isabella flood control and irrigation benefit project, involving a large dam and reservoir at Isabella which would affect sections of the Kern River.

Owens River, Inyo and Mono Counties. Hydroelectric power project in the Owens River Gorge affecting some five miles of river above Birchim Canyon.

Colorado River, San Bernardino-Riverside Counties. U. S. Bureau of Reclamation.

A. Upper section affecting Nevada, Arizona and California from Davis Dam, Arizona to Needles, California. Davis Dam, a hydroelectric booster plant for Hoover and Parker Dams power plants—created a 65-mile long fishing reservoir. Studies were primarily on the effects of cold water releases to the river section below the dam.

B. Upper section from Needles, California, to Topock, Arizona. River channelization over a 10-mile strip isolating and draining ox-bow lakes and sloughs with relative destruction to fish life present.

C. Middle section from Taylor's Ferry to Palo Verde Lake in Cibola Valleys. Channelization to drain and reclass slough areas for agricultural uses and to drop elevations of outlets of waste irrigation drains with accompanying distress to fishes utilizing this habitat.

Santa Ynez River, Santa Barbara County. Construction of Cachuma Dam by Bureau of Reclamation creates a barrier across the present steelhead stream in Southern California. The impoundment which provides domestic and irrigation water for Santa Barbara and Central Coastal areas, may be utilized for public fishing.

Santa Clara River Drainage. Flood control project.

Santa Ana River Drainage.

Of smaller individual proportions than the above major projects, but in the aggregate of considerable importance to fish life, are the numerous small diversions from our streams and rivers. All new applications for permission to appropriate water are filed with the State Division of Water Resources and are reviewed by the Division of Fish and Game. In cases where there is definite threat of injury to fish, the Division of Fish and Game enters a protest, with a statement of the conditions under which the protest may be dismissed. In most instances these conditions consist of the release of a certain flow of water to the stream below the diversion for the preservation of fish life. The disposition of protests made by the Division of Fish and Game during the biennium and during the preceding biennium is shown in Table 8.

TABLE 8. DISPOSITION OF PROTESTS BY CALIFORNIA DIVISION OF FISH AND GAME AGAINST APPLICATIONS TO APPROPRIATE WATER IN 1946-48 AND 1948-50

	1948-50	1946-48
Total number of applications to appropriate water	1,248	1,126
Number of applications protested by Division of Fish and Game	71	49
Protest accepted	24	19
Protest pending	34	20
Applications cancelled	6	2
Protest withdrawn after further investigation	3	2
Informal hearing—settlement by agreement	3	3
Informal hearing—action pending	0	2
Formal hearing—compromised	1	1
	71	49

The importance of water in the economy of California is well appreciated by the Division of Fish and Game, and in the cases of all protests that we have entered we have carried out careful field investigations to avoid protests that cannot be justified. The wisdom of this policy is borne out by the fact that during the period covered informal field hearings have been necessary in only three cases and only one formal hearing has been required. In the latter case there were a number of protestants other than the Division of Fish and Game.

FISH DISEASE STUDIES

During the biennium a trained parasitologist was added to the staff to cope with the many and often complex and puzzling problems created by fish diseases.

Work of the disease unit is divided into two parts: (1) the diagnosis and treatment of diseases of hatchery and wild fish, and (2) research concerned with diseases and nutrition of fish.

The major portion of diagnosis and treatment has been done at the state fish hatcheries. Correct diagnosis has enabled the selection of proper treatments which when used promptly have prevented the occurrence of heavy losses. In addition to hatchery disease problems, diseased fish submitted by fishermen and commercial trout farms were examined and diagnoses made.

Research problems being carried on are the following:

1. The study of *Cryptobia* sp., a blood inhabiting protozoan found in salmonid fish. This investigation is concerned with the distribution of the parasite and its possible role in the fluctuating runs of anadromous fishes.
2. The study of a myxosporidian parasite has been carried on and work is continuing on attempts to discover a resistant species of trout, with encouraging results to date.
3. Various drugs and chemicals have been screened for possible use in the treatment of fish diseases. Among the more promising drugs are phenothiazine, sulfamerazine, and pyridylmercuric acetate.

POLLUTION CONTROL

Considerable progress in the abatement of pollution affecting fish and wildlife has been shown during the biennium. In 1948, critical conditions led to the appointment by the Division of Fish and Game of two sanitary engineers for surveys and to supply technical assistance in the prosecution of pollution cases. By this time in a number of places in the State, the wartime and postwar expansion of population and industry had seriously overloaded the existing waste treatment facilities. At other locations disposal facilities had never been constructed and the resulting water pollution was more serious than even before, particularly in the Central Valley and San Francisco Bay areas.

The primary pollution problems of interest to the Division of Fish and Game have occurred on the Central Valley salmon rivers, particularly the Tuolumne, San Joaquin, and Mokelumne. Following court action instituted by the Division of Fish and Game against the City of Modesto in 1947, sewage disposal facilities have been constructed, but a considerable organic load is still discharged to the river. In both 1948 and 1949 water releases were required to get the salmon runs up the river. The salmon of the Tuolumne have not yet been completely protected from the dangers of pollution and a survey has recently been completed to evaluate the effects of the wastes now going into the river and those that are proposed for future discharge. Conditions for the salmon run in 1950 are satisfactory because of the small tonnage of tomatoes processed this year.

A great deal of improvement has been observed on the Mokelumne since 1948. All of the wineries in the vicinity of Lodi now have facilities for impounding their wastes and no fish mortality or severe oxygen depletion has been observed for the past two years. Severe pollution still exists at Stockton in the ship channel and in the San Joaquin River, but conditions are not nearly as bad as before 1949. A court action similar to that taken against the City of Modesto was instituted against the City of Stockton in that year and stipulations were obtained whereby the city will construct a certain amount of additional treatment facilities each year until complete treatment is provided in 1954. The length of the San Joaquin River that is septic during the canning season has been reduced from about 10 to less than three miles as a result of the construction during the last two years.

A study was made of the feasibility of using bottom organisms as indexes of pollution along the water front between Martinez and the Antioch Bridge. The rapid expansion of heavy industry in this area can be counted upon to present increasing pollution problems in the future as the load of industrial wastes builds up. Unfortunately so few macroscopic bottom organisms were present in these waters that the above approach appears to hold little promise. This scarcity of bottom organisms has tentatively been attributed to the continual changes in salinity which characterize the area.

In 1949 the Assembly Interim Committee on Water Pollution proposed a sweeping series of changes in the existing laws. The resulting legislation established a State Water Pollution Control Board and nine regional boards for the purpose of coordinating pollution control activities and establishing pollution policies at the local level. The Division of

Fish and Game was directly affected by the addition of Section 481.5 to the Fish and Game Code, which provides that all continuing and chronic cases of water pollution be turned over to the local boards for action. The 1949 laws also provide that any persons desiring to discharge sewage or industrial waste apply to the regional boards for requirements that will have to be maintained by the operator of the disposal system. The regional boards establish these requirements after consultation with the state and local agencies interested in the problem. The Division of Fish and Game has the responsibility of furnishing any technical information or investigations on the fish and wildlife aspects of any case of pollution requested by the regional boards. The boards are now beginning to realize the importance of recreation, fish, and wildlife insofar as pollution and water use are concerned. The intention of the Legislature was for these boards to have small staffs and to utilize existing state departments and facilities. Until now the various boards have processed only applications for new waste discharges and very little has been done with the chronic cases of stream pollution. Within a short time it is anticipated that the regional boards will be in a position to begin to abate some of the conditions which are the source of complaints at the present time.

The number of requests for investigations and surveys that come in from both the regional boards and field personnel of the Division of Fish and Game far exceed the load that can be carried by the available personnel. The State Water Pollution Control Board recognizes that the interest of the Department of Natural Resources in pollution control is as great as that of any other state agency, but this recognition is not widespread. The pollution control investigations carried on by the three state departments interested in the problem have now been grouped and the entire pollution investigation program of the State is administered by a coordinating committee composed of three representatives, one each from the Department of Public Health, the Department of Public Works, and the Division of Fish and Game.

In the past, agencies dealing with water use have not recognized the fish and game aspects or the magnitude of the industry they support, partly because of the limited program of the Division of Fish and Game as compared with those of the other state departments. This attitude is unfortunate, particularly insofar as pollution is concerned, because of the extreme interest of the sportsman in clean waters and the vital need of using all waters possible for recreation in our existing society. It is regrettable that any waters that could be used for fish, wildlife, and recreation in this day of water shortages should be befouled by sewage beyond the point of any possible use.

The years 1948-50 have seen a great deal of construction for domestic sewage treatment. The postwar building programs of cities have finally produced results and treatment plants are being completed and put into operation. A good example is the eastern side of San Francisco Bay. Plans were started before the war, the bond issue was passed in 1947, and construction will be completed in 1951. This will relieve the septic conditions along the bay and estuary and also the odors along the Eastshore Freeway.

Much work needs to be done before the industrial waste problems in the State can be solved. The food processing industry has installed a number of screens and in cases where the city disposal plant accepts the

waste a considerable amount of treatment is provided, for example at Stockton and Modesto. The San Jose-Santa Clara area has passed a bond issue for construction of treatment facilities, but the plant will not be completed for two or three years. It seems likely that we will soon see additional pulp mills in the State; in fact, preliminary negotiations have begun with the builders of a proposed pulp mill on the McCloud River. A great deal of work remains to be done by the lumber industry all over the State. The cutting and hauling operations result in a large amount of debris being deposited in the streams, with resultant obstructions to migrating fish and pollution due to sawdust and bark. The problem of the effluent from millponds entering streams and killing fish is also serious and an educational campaign is being carried out in order that sawmill operators will drain ponds only during periods of high flow.

One of the most common causes of complaint is the recurring problem of oil spills, particularly from ships. The number of cases has decreased considerably since the years before the war, probably due to the patrol activities of the Division of Fish and Game. The prosecution of oil pollution cases may take place under either federal or state statutes, but in practice the majority of cases are handled in the local state courts by local patrol personnel.

Probably the most encouraging development during the last biennium has been the increased number of potential pollution cases that have been taken care of before pollution has occurred. This has been made possible by the increased public attention being given to water pollution and is the "payoff" of many years work by agencies and organizations, such as sportsmen's groups interested in water pollution control. With the establishment of the regional water pollution control boards, it is anticipated that no new sources of pollution will be allowed to discharge into state waters to the detriment of fish and aquatic life. Our experience has shown that the best time for pollution prevention is while plans are in the formative state, not after the treatment plant or the new industrial plant is completed.

Two recent instances demonstrate this point. The Masonite Corporation has recently completed a new plant at Ukiah. Originally it was proposed to use the Russian River for waste disposal and it was apparent that this would create intolerable conditions in the river. After nearly two years of negotiations the problem was solved by the installation of evaporators before the plant went into operation, thus creating a "tight" plant with no waste discharge. Another example of this predischarge control occurred at the City of Gridley. Without realizing the consequences the city proposed to put a series of sewer ponds immediately adjacent to the Gray Lodge Waterfowl Refuge. The hazard of botulism to waterfowl feeding in septic ponds is extremely serious, and any proposal to locate sewage disposal ponds in close proximity to any concentration of ducks must be treated with extreme caution. In this instance negotiations with the city and the consulting engineer resulted in the removal of the treatment plant site to the other side of town, near the Feather River, where gravel deposits are much more suited to pond construction because of the additional percolation. By this planning the hazard to waterfowl was eliminated and when final plans were completed the cost to the treatment plant had been reduced.

The state program for pollution abatement is based on preventing all new sources of pollution and then setting requirements to be met by the existing cases. The first portion of this program is well under way and the second phase is getting started. It is hoped that progress will continue until the present hazard to our fisheries resources is removed and the large areas of streams and bays now unsuitable for recreational use are restored to a useful condition.

INTERSTATE WATERS

In addition to the program on the Colorado River being conducted jointly with the State of Arizona, several conferences were held with personnel of the Nevada Fish and Game Commission, resulting in cooperative working plans for interstate waters which should assist both states in better management of these waters.

WILDLIFE CONSERVATION BOARD PROJECTS

At its 1947 Session the State Legislature adopted an act known as the Wildlife Conservation Act of 1947 and transferred $9,000,000 due the State from horse racing operations from the General Fund to the Wildlife Restoration Fund. This fund, to be used for capital expenditures, is administered by the Wildlife Conservation Board. The board receives proposals for projects from sportsmen's and other conservation groups, federal and state agencies, and individuals and passes on their worth. Approved projects are allocated funds, which are then transferred to the Fish and Game Commission, which carries out the actual construction, operation, management, and maintenance of the projects.

FIGURE 17. Right wing of flow maintenance dam at Stony Ridge Lake, El Dorado County. Note outlet box in left center of photograph, at end of dam, to regulate flow in stream below dam.

It is obvious that such a comprehensive program must draw heavily on the services of Division of Fish and Game personnel at all stages. As projects involving the inland sports fisheries, other than hatchery projects, have been submitted during the biennium the members of the biological staff have been called upon for field investigations, planning, and preparation of reports and recommendations. A summary of the status of Wildlife Conservation Board nonhatchery fish projects at the end of the biennium is presented herewith:

PROJECT 1. EL DORADO FLOW MAINTENANCE DAMS

Board allocated $35,000 6/3/49 and $65,000 8/25/49; Fish and Game Commission approved 9/23/49. Barrier dam at Richardson Lake and flow maintenance dams at Stony Ridge and Crag Lakes completed in 1949. Active plans are under way for the construction of three flow maintenance dams in the Rubicon River drainage, scheduled for completion this summer. District Fisheries Biologist J. C. Fraser is now working on contracts for pack stock. $2,000 was transferred from this project to the Division of Water Resources in June to cover costs of survey investigations.

PROJECT 2. DEEP CREEK STREAM IMPROVEMENT (HOLCOMB CREEK DAM)

Board allocated $25,000 1/26/50; Fish and Game Commission approved 1/28/50. $1,500 has been transferred from 7XD52 to Division of Water Resources for plans and surveys. Mr. Norris of the Division of Water Resources and District Fisheries Biologist W. A. Evans are scheduled to make a field inspection on or about July 14, 1950, in order to reach a final decision regarding location of the dam site.

PROJECT 4. PINE CREEK FLOW MAINTENANCE DAM

Board allocated $43,500 6/3/49; Fish and Game Commission approved 9/23/49. A fish trap was constructed in 1950 for counts and studies of migrating fish. Studies are now being conducted by District Fisheries Biologist H. A. Hanson and project held in abeyance.

PROJECT 12. MENDOCINO FOREST STREAM IMPROVEMENT

Board allocated $5,000 5/18/50. A reconnaissance of stream improvement possibilities on Stony, Grindstone, and Thomes Creeks was made by District Fisheries Biologist G. I. Murphy and Dr. P. R. Needham of the University of California in June, 1950, and the results of their investigation are now being studied.

PROJECT 16. EMIGRANT BASIN FLOW MAINTENANCE DAM AND STREAM IMPROVEMENT PROGRAM

Board allocated $50,000 8/25/49; Fish and Game Commission approved 9/23/49. $2,000 was transferred from 7XD32.1 to the Division of Water Resources for plans and investigations in June, 1950.

PROJECT 41. GRANITE CREEK FLOW MAINTENANCE

Board allocated $30,000 8/25/49; Fish and Game Commission approved 9/23/49. A cooperative agreement is being drawn up by the U. S. Forest Service and should be transmitted shortly. The Forest Service is prepared to start construction at the close of engineering studies.

PROJECT 42. MARSH LAKE LEVEL MAINTENANCE

Board allocated $4,000 8/25/49; Fish and Game Commission approved 9/23/49. Final report and plans needed before any construction can be undertaken, but it is hoped to complete the work in 1950.

PROJECT 43. BENNETT AND SMITH FISH LADDER

Board allocated $6,000 8/25/49; Fish and Game Commission approved 9/23/49. Division of Architecture is working on plans and specifications, and permission was received on June 12th from the owner to go ahead with construction.

PROJECT 44-2. BURNT RANCH FALLS FISH LADDER

Board allocated $8,000 8/25/49; Fish and Game Commission approved 9/23/49. Studies to date indicate that feasibility of this project is somewhat doubtful. Division of Architecture requested to make study and report.

PROJECT 49. TAHOE FOREST FLOW MAINTENANCE AND IMPROVEMENT PROGRAM

Board allocated $40,000 8/25/49 to initiate program and complete essential work. Fish and Game Commission approved 9/23/49. Barrier dam at Miller Lake completed in 1949. $1,000 was transferred in June from 7XD35.2 to the Division of Water Resources for plans and investigations.

PROJECT 51. SEQUOIA NATIONAL FOREST FLOW MAINTENANCE PROGRAM

Board allocated $50,000 8/25/49; Fish and Game Commission approved 9/23/49. Sample agreements for the construction of Millwood and Indian Basin Lakes were received from the U. S. Forest Service on June 26. The sample agreements were very satisfactory and the signed agreements are expected shortly for submission to the Department of Finance.

PROJECT 57. SAN DIEGO RIVER FLOW MAINTENANCE AND DEVELOPMENT PROGRAM

Board allocated $35,000 8/25/49; Fish and Game Commission approved 9/23/49. Progress in the investigation of this project has been delayed pending receipt of basic information from the County of San Diego.

PROJECT 58. SAN DIEGO COUNTY FLOW MAINTENANCE PROGRAM

Board allocated $25,000 8/25/49; Fish and Game Commission approved 9/23/49. Project requires further detailed study.

PROJECT 61. SHASTA RIVER FISH COUNTING DAM

Board allocated $16,000 8/25/49; Fish and Game Commission approved 9/23/49. A lease for site has not yet been approved in Sacramento. Project was turned over to the Division of Architecture and Public Works Board. Approval was asked on June 22, 1950.

PROJECT 62. CANYON CREEK FISH LADDER

Board allocated $10,000 12/13/49; Fish and Game Commission approved 1/6/50. The Goldfield Consolidated Mining Corporation is giving up their lease on this property on June 30, 1950. During the month of June, District Fisheries Biologist J. H. Wales investigated this project with the general objective of removing the dam completely or building a smaller dam some distance upstream, since the estimated cost of a fishway was excessive. Negotiations will be undertaken with the owner of the dam to achieve one of these objectives.

PROJECT 63. SAWYER'S BAR AUXILIARY DAM

Board allocated $3,500 6/3/49; Fish and Game Commission approved 9/23/49. Division of Architecture is drawing up plans and specifications, and permission for preliminary planning was received from the owner on June 20, 1950.

PROJECT 67. SACRAMENTO RIVER WEIR (ROUGH FISH CONTROL BARRIER)

Board allocated $18,000 3/19/49; Fish and Game Commission approved. Project being further studied. Construction being deferred.

PROJECT 72. RAMER LAKE

This project is completely authorized and Public Works Board approval was requested on June 5, 1950. An inspection by an engineer from the Division of Water Resources and District Fisheries Biologist W. A. Evans is pending.

PROJECT 73. CRYSTAL LAKE LEVEL MAINTENANCE

Board allocated $20,000 8/25/49; Fish and Game Commission approved 9/23/49. Forest Service will make installation for the Division of Fish and Game during the summer of 1950 under an approved cooperative agreement.

PROJECT 74. COACHELLA VALLEY PUBLIC FISHING AREAS

Board allocated $32,500 1/26/50; Fish and Game Commission approved 1/28/50. No water supply commitment has been received as yet. Maintenance has been tentatively accepted by the Board of Supervisors of Riverside County. District Fisheries Biologist W. A. Evans is planning a meeting for field inspection.

PROJECT 76. CLEAR LAKE REARING POND

Project completed.

PROJECT 77. LINDO LAKE PUBLIC FISHING AREA

Board allocated $11,000 1/26/50; Fish and Game Commission approved 1/28/50. Agreement was received from the County of San Diego on June 20th and forwarded to Sacramento for approval. On June 29th the agreement was sent back not approved because the amount of money to be expended was apparently over the $10,000 limit on projects that may be performed with the services of the Division of Architecture. Attempts are being made to straighten out this difficulty.

PROJECT 79. SULPHUR CREEK DAM

The original cost estimate of $22,000 received from Division of Architecture was too high and it has been requested to resurvey the site at lower water flows.

PROJECT 81. SAN BERNARDINO NATIONAL FOREST

Board allocated $35,000 1/26/50; Fish and Game Commission approved 1/28/50. Field investigations are under way.

PROJECT 82. DRY LAKE LEVEL MAINTENANCE

Board allocated $4,500 1/26/50; Fish and Game Commission approved 1/28/50. Conferences with the U. S. Forest Service are planned.

PROJECT 83. BIXBY SLOUGH PUBLIC FISHING AREA

Board tentatively approved allocation of $100,000 at April, 1950, meeting, for a cooperative development of Bixby Slough. Necessary data and commitments from local interests being awaited.

PROJECT 86. SAN ANTONIO CREEK PUBLIC FISHING AREA

Board allocated $20,000 5/18/50; Fish and Game Commission approved 5/19/50. Field investigations being conducted.

PROJECT 1010. DELTA FISH AND GAME OPERATIONS BASE

Board allocated $27,000 5/18/50; Fish and Game Commission approved 5/19/50. Negotiations to secure site under way.

CHILDREN'S FISHING WATERS

Many municipalities were aided in establishing permanent fishing ponds for children. For example, the Los Angeles City Park and Recreation Department was assisted in establishing its successful fishing program in the city park lakes, and catch data were obtained.

STEELHEAD AND SALMON

The steelhead trout and salmon of California represent a tremendous resource. This resource, of the greatest importance in the economy of the State, is under constant threat from large-scale dam construction. One of the main goals of the Bureau of Fish Conservation, therefore, has been to acquire as rapidly as possible the essential facts necessary for the preservation and management of our steelhead and salmon fisheries in our expanding and changing economy.

The present applied steelhead and salmon management program of the bureau includes rescue of fish from drying streams, removal of

abandoned dams and other barriers, construction of fishways, and stocking with hatchery fish. The activities of the biological staff in connection with these phases of the program are described elsewhere in the report. Some of the important special fact-finding investigations carried on during the biennium are summarized herewith.

For some years the Bureau of Fish Conservation has carried out counts of spawning steelhead and salmon at various stations. Such counts provide a basis for legislative and management programs and for recommendations in connection with proposed large dams. In 1950, all such work not already under the direction of the district biologists in the respective districts was placed under their supervision. Listed below are the counting stations operated by the Bureau of Fish Conservation:

Station	*Name of stream*	*County*	*River system*
Klamathon Racks	Klamath River	Siskiyou	Klamath River
Shasta Racks	Shasta River	Siskiyou	Klamath River
Sweasy Dam	Mad River	Humboldt	Mad River
Benbow Dam	Eel River, S. Fk.	Humboldt	Eel River

On November 1, 1948, a graduate college student working as a student biologist began a study of the efficiency of natural propagation of our steelhead and salmon and the factors affecting it. This study is being carried out in the Prairie Creek drainage, Humboldt County, and will include two winter seasons of field work. The first of these seasons was that of 1948-49 and the second will be that of 1950-51.

Another study which will in part complement the above was started at Fall Creek, Siskiyou County, in 1949. In this study different numbers of king salmon will be allowed to enter and spawn in Fall Creek each year. The resulting offspring will then be counted on their downstream migration to the Klamath River. From known numbers of parents and known numbers of offspring we hope to determine the most effective number of king salmon for a spawning tributary such as Fall Creek.

The planting of steelhead in the Sacramento River from the federal hatchery at Coleman was supervised by the biologist in charge of District 2. A number of these steelhead were tagged with celluloid disk tags in an attempt to determine the return to the angler before and after the fish had gone to sea.

INLAND TROUT

Although existing evidence indicates that the bulk of the trout caught by anglers in California as a whole result from natural propagation, the hatcheries of the State play a very important role in supplying fish to a number of waters which otherwise would be incapable of producing satisfactory angling.

In this program it is one of the principal functions of the biological staff to make the necessary initial surveys of waters and then to check them as necessary in order to keep stocking and general management policies in line with existing conditions. The records and policies for each managed water are kept current by means of a state-wide system of "hatchery management binders." These are permanent records in loose-leaf form, kept at each hatchery, with duplicate copies at the district office, which show the essential survey data for the managed water,

a summary record of past stocking, and the basic stocking and general management policy as determined in conference between the biological and hatchery staffs.

Special investigations dealing with the inland trout fisheries carried on by the biological staff include studies of hatchery diets and fish diseases, test water programs, and studies of important individual bodies of water. These are described elsewhere in this report.

In order to test the value of stocking interior-stock fall-spawning rainbows in steelhead and salmon waters, 50,000 advanced fingerlings were marked and planted in several streams along the Mendocino County coast. Less than 12 authenticated returns to the angler in the year after stocking indicate that such stocking in coastal streams is not justified.

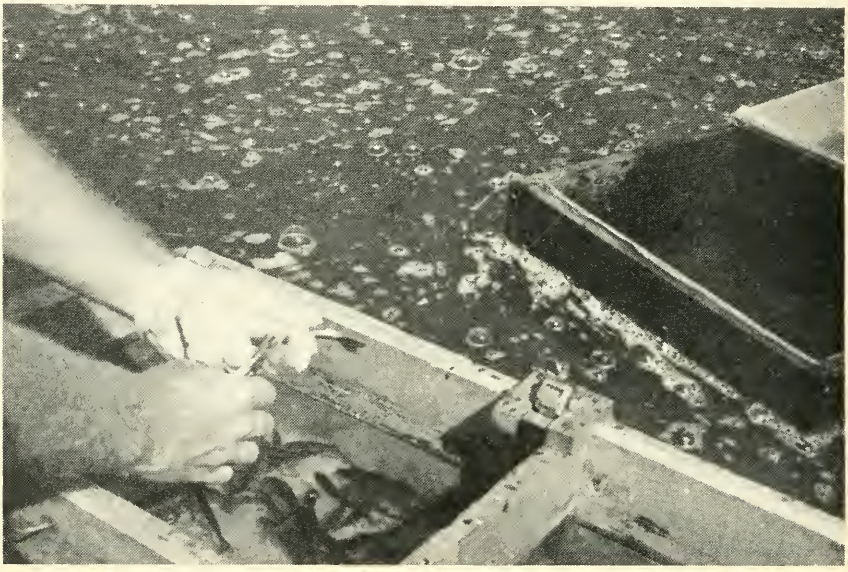

FIGURE 18. Marking rainbow trout at San Joaquin Experimental Hatchery, Fresno County. One of two fins is removed with clippers, so that after stocking the marked fish can be recognized as belonging to the particular group regarding which information is needed. *Photograph by Scott Soule.*

WARM-WATER FISHES

The warm-water fisheries program of the Bureau of Fish Conservation was greatly intensified and expanded near the beginning of the biennium. Two members of the biological staff were assigned to warm-water fisheries investigations on practically a full-time basis, and other members of the staff have devoted considerable time to the program.

Following initial exploratory studies, several typical problem waters were selected for intensive study. These included Clear Lake in Lake County, Millerton Lake in Fresno and Madera Counties, and Don Pedro Reservoir in Tuolumne County. The intensive studies at these waters have been followed by widespread sampling of the populations of young fish in a large series of reservoirs throughout the State. Results generally have indicated adequate largemouth black bass reproduction coupled with very inadequate forage for the bass of the year's hatch.

Steps to correct this situation by introducing golden shiners and other forage fishes were being taken at the end of the biennium. Other work in connection with the warm-water fisheries is described elsewhere in this report.

FIGURE 19. Fish tagging at Millerton Lake, Fresno and Madera Counties. A numbered metal strap tag is being attached to the upper jaw of a largemouth black bass. Tags are used when information regarding individual fish is needed. *Photograph by C. K. Fisher.*

STRIPED BASS

The catch record system for this important fishery was coordinated and placed on a firm foundation. A large volume of party boat records which had accumulated since 1938 was analyzed and interpreted. The handling of records of this type was put on a routine maintenance basis. Together with the statewide postal card estimates they now provide a continuous, up-to-date inventory of the fishery.

A fairly ambitious tagging program aimed at evaluating the rate of harvesting by anglers was begun early in 1950. It was made possible by the acquisition of the 28-foot boat "Striper." A total of 1,899 striped bass was tagged late in the biennium. Special studies were also made to test the resistance to corrosion of various metals used with disk tags. Such corrosion has proved to be a serious problem.

Surveys of the abundance of fingerling striped bass on the nursery grounds in June and July revealed the presence of large numbers in 1948, 1949, and 1950. There have not been enough of these surveys to establish a norm, but there is every indication that spawning and survival

to the fingerling stage has been average or better in the three years mentioned.

Liaison was maintained with the U. S. Bureau of Reclamation in connection with the Delta Mendota Diversion near Tracy. This diversion threatens to destroy significant numbers of striped bass. The Bureau of Reclamation has agreed to install complete fish screens at the initial temporary small-scale diversion and to carry on intensive studies of fish losses there. The Bureau will also investigate the practicability of the various remedial measures which have been suggested.

FARM POND PROGRAM

It is the policy of the Division of Fish and Game to supply an initial stock of warm-water fishes to private ponds too small to support public fishing and which meet certain other requirements. Trout for such ponds must be purchased from a Licensed Domestic Fish Breeder.

The usual combination of largemouth black bass and bluegill sunfish has not worked out well in some ponds, and so we have initiated some experiments with other combinations in a few scattered ponds representative of the area in which they are located.

In all, the biologists spend about 5 percent of their time on the farm pond program. They process applications for fish and inspect the pond if there is doubt as to its qualifications or there is possibility of escape of bass and sunfish into trout waters.

In summary, during the biennium 467 applications for stocking of private ponds were processed, 222 ponds were visited, and 325 ponds were stocked with fish.

LEGISLATION AND REGULATIONS

Recommendations for changes in fishing laws and regulations, based on survey data on their general knowledge, have been submitted by members of the biological staff as required.

PUBLIC INFORMATION

Personnel of the biological staff devoted considerable time to appearances before sportsmen's clubs and other conservation groups and on radio and television programs, as well as to the preparation of printed information. About 280 talks were made at meetings throughout the State, plus 22 radio and 6 television appearances. In addition, conservation motion pictures were shown many times. Numerous conferences in connection with fishery protection and development were attended and advice was rendered to sportsmen in connection with a number of club projects.

The printed material consisted of published articles, which are listed in this report, and also of mimeographed information leaflets, pamphlets for school children prepared in cooperation with the State Department of Education, and fishing maps. The latter, issued as folders with the map on one side and informational material on the other, have proved very popular. The "Striped Bass Fishing Map" was published during the biennium and maps of the Colorado River area, the Marble Mountains Wilderness Area, and black bass fishing waters were prepared and will be issued shortly.

PUBLICATIONS BY STAFF MEMBERS OF THE BUREAU OF FISH CONSERVATION

Calhoun, A. J.

1949. California striped bass catch records from the party boat fishery: 1938-1948. Calif. Fish and Game, vol. 35, no. 4, p. 211-253.
Trout in San Francisco's backyard. West Coast Sportsman, vol. 6, no. 12, p. 40.

1950. California's striped bass. Outdoor West Magazine, vol. 2, no. 3, p. 6-7, 28-29, May-June.

Calhoun, A. J., and C. A. Woodhull

1948. Progress report on studies of striped bass reproduction in relation to the Central Valley Project. Calif. Fish and Game, vol. 34, no. 4, p. 171-187.

Calhoun, A. J., C. A. Woodhull and Wm. C. Johnson

1950. Striped bass reproduction in the Sacramento River system in 1948. Calif. Fish and Game, vol. 36, no. 2, p. 135-145.

Curtis, Brian

1949. The warm-water game fishes of California. Calif. Fish and Game, vol. 35, no. 4, p. 255-273.

Curtis, Brian, and J. C. Fraser

1948. Kokanee in California. Calif. Fish and Game, vol. 34, no. 3, p. 111-114.

Evans, Willis A.

1950. Aquatic weed control and fish life. Report Second California Weed Conference, p. 85-87.

Evans, W. A., and O. L. Wallis

1949. Fishes of Yosemite National Park. Yosemite Nature Notes, vol. 23, no. 1, 1944. 2d edition, revised 1949. 32 p.

Murphy, Garth I.

1948. A contribution to the life history of the Sacramento perch (*Archoplites interruptus*) in Clear Lake, Lake County, California. Calif. Fish and Game, vol. 34, no. 3, p. 93-100.

Notes on the biology of the Sacramento hitch (*Lavinia e. exilicauda*) of Clear Lake, Lake County, California. Calif. Fish and Game, vol. 34, no. 3, p. 101-110.

1949. The food of young largemouth black bass (*Micropterus salmoides*) in Clear Lake, California. Calif. Fish and Game, vol. 35, no. 3, p. 159-163.

1950. The closed season in warm-water fish management. Trans. 15th North American Wildlife Conf., p. 235-251.
The life history of the greaser blackfish (*Orthodon microlepidotus*) of Clear Lake, Lake County, California. Calif. Fish and Game, vol. 36, no. 2, p. 119-133.

Taft, Alan C., and Garth I. Murphy

1950. The life history of the Sacramento squawfish (*Ptychocheilus grandis*). Calif. Fish and Game, vol. 36, no. 2, p. 147-164.

Soule, S. M.

1950. Initial planting of golden trout in Hooper Creek drainage, Fresno County, California. Central California Sportsman, vol. 9, no. 7, p. 132-133, 136-137.

Vestal, Elden H.

1949. A Piute trout transplant. Central California Sportsman, vol. 8, no. 10, p. 164-166.

TITLES AND ABSTRACTS OF ADMINISTRATIVE REPORTS SUBMITTED BY THE BIOLOGICAL STAFF

July 1, 1948, to June 30, 1950

Beck, Ralph V.

Creel Returns From Crowley Lake, Mono County, California, Season of 1949. Submitted November 18, 1949. 10 pp., including 7 figures and 4 tables.

ABSTRACT: A creel count was made at Crowley Lake by members of the fisheries staff during five four-day periods in the 92-day fishing season. During the 20 days of census 3,930 anglers fished 21,313 hours and caught 2,925 fish, including 2,349 rainbow (80.3 percent), 219 brown trout (7.5 percent), and 357 Tahoe cutthroat trout (12.2 percent). The average catch was 0.74 and the average catch per angler per hour was 0.14. In 1947 the average catch and average catch per angler per hour was 1.2 and 0.19 respectively, and in 1946 they were 2.0 and 0.33, indicating a gradual decline in the fishery. The percentage of brown trout and Tahoe cutthroat trout caught was greater in 1949 than in the two previous years. It is estimated that 52,249 people fished Crowley Lake during the entire 92-day season and caught a total of 38,887 trout of all species.

Calhoun, Alexander J.

1946 Angling Catch Records. Submitted July 28, 1948. 80 pp., 26 tables, 10 figures.

ABSTRACT: Angling catch questionnaires were sent to a random sample of 3.9 percent of the 766,753 licensed anglers in California in 1946. Total catch trends in recent years appear to have been relatively stable for trout, salmon and catfish. They appear to have decreased slightly for striped bass, and to have increased for black bass, sunfish and crappie. Numbers of anglers have increased sharply for all species, and there has been a corresponding decrease in the mean annual catch of all species, least extreme in the case of spiny rays. The validity of estimates derived from postal card survey, the county of residence distribution of licensed anglers, and migrations of trout and striped bass anglers from county of residence to county of catch are discussed in the report.

Calhoun, Alexander J., and G. M. Christman

Migration of California Trout Anglers in 1948. Submitted September, 1949. 5 pp., 10 figures and 2 appendixes.

ABSTRACT: The 1948 migrations of licensed California trout anglers from six residence areas to eight trout fishing regions within the State are outlined in a series of tables and diagrams. Estimates of the numbers of trout caught by anglers making the various migrations are included.

Calhoun, Alexander J., and Charles E. Warren

The Effect of Increased Towing Speed Upon Tow-net Catches of Small Striped Bass. Submitted August 2, 1949. 8 pp.

ABSTRACT: The tow-net used in studies of striped bass fry is described. Results of a series of test tows at different speeds indicated decreasing efficiency of the net at speeds over 2.7 feet per second. No significant difference in length frequencies was apparent at the different speeds used, ranging from 2.7 to 6.6 feet per second.

Coots, Millard

Fish Rescue 1949. Stream Improvement Headquarters, Yreka. Submitted April 3, 1950. 2 pp. including one table.

ABSTRACT: During the summer of 1949, 56,688 young salmonids, consisting of 21,832 silver salmon and 34,856 steelhead, were rescued from drying streams and irrigation ditches tributary to the Scott and Klamath Rivers. This work was done by a biological aid with assistance from the Stream Improvement Headquarters staff.

Creel Census—April 29, 1950. Klamath River, Siskiyou County. Submitted May 16, 1950. 3 pp.

ABSTRACT: Angling activity on the Klamath River was checked on this date. 222 anglers were counted between Copco and the Scott River, a river distance of about 53 miles. 87 anglers were interviewed, including 42 who had completed their angling effort. The average fishing time was 3.5 hours, the average catch 9.4 fish, catch per angler hour 2.7, estimated total catch 2,082. The catch consisted mostly of immature steelhead, plus a few spent adult steelhead, immature salmon, and yellow perch. 261 trout were measured, ranging from 4.0 inches to 13.9 inches (fork length). The mean length was 6.58 inches.

Curtis, Brian

Report of the Activities of the Biological Staff of the Bureau of Fish Conservation for the Fortieth Biennium, July 1, 1946, to June 30, 1948.

ABSTRACT: Describes the activities of the staff. Printed in large part in "Fortieth Biennial Report of the Division of Fish and Game" as part of the report of the Bureau of Fish Conservation.

Douglas, Philip A.

Rough Fish Control in Elizabeth Lake Canyon Drainage, Los Angeles County. Submitted December 28, 1949. 21 pp., including 13 figures, 6 tables, 1 graph, plus Appendix A and 2 sketch maps.

ABSTRACT: A decline in the fishing success for largemouth black bass, bluegill, crappie, catfish in the Elizabeth Lake Canyon drainage, Los Angeles County, necessitated a study of causative factors.

A heavy population of greaser blackfish *Orthodon microlepidotus* (Ayres) was found to be present in the four major bodies of water in the drainage, and stomach analyses indicated that they were of little forage value to the largemouth black bass in the area.

Plans were laid for a 2-day treatment program distributing 1,600 pounds of cube root-3½ percent rotenone, over 160 surface acres or 655 acre-feet of water, or a concentration of 0.90 p.p.m. of the chemical was used. (A high concentration of rotenone was used due to the alkaline waters involved.) The blackfish was found to be the most susceptible to the chemical, appearing in distress within thirty minutes following application of the rotenone. An estimated kill in waters treated was 605,601 rough fish (95 percent) and 26,017 game fish (5 percent). One lake had a natural kill October 12, 1949, and no new fish appeared following treatment.

A restocking program for 1950 for the public lakes is based on a comparative basis of percentage compositions by species of the original stocking between 1938 and 1945 of Lake Hughes, and the percentage composition of the same fish population estimated following the chemical treatment of November 26, 1949.

From the above figures the following was noted: Largemouth black bass decreased slightly; bluegill decreased considerably; catfish increased moderately; and black crappie increased considerably.

A stocking program for the public waters has been proposed for 1950.

Evans, Willis A.

A survey of the city park lakes of Los Angeles in relation to their proposed use for children's fishing recreation, Los Angeles County. Submitted March 20, 1949. 22 pp., including eight figures and five maps.

ABSTRACT: A survey of the five Los Angeles City park lakes was made during January, 1949, to determine their adaptability to a children's fishing program. Three out of the five lakes are believed suitable for development and use within the year. The other two may be utilized as brood ponds to serve the other three. Fishing should be carried on under as natural conditions as possible. Physical and biological characteristics of the individual lakes are briefly discussed and recommendations for fish management in each presented.

Fraser, J. C.

Supplementary Report No. 1 on the Emigrant Basin Flow Maintenance Dam and Stream Improvement Program (Wildlife Conservation Board Project No. 16). Tuolumne County. Submitted January 6, 1950. 23 pp., including three tables, 1 photograph.

ABSTRACT: Describes certain subprojects, including 4 new ones, and gives a revised status of subprojects in this program based on field surveys made in 1949.

1949 Lake Tahoe Party Boat Catch Records, Placer/El Dorado Counties. Submitted January 9, 1950. 8 pp., 3 tables.

ABSTRACT: Seven guide fishermen operated from California ports in 1949, making 357 trips with a total of 587 anglers. Catch consisted of 1,009 mackinaw, 6 rainbow trout, and 5 brown trout, total weight of all trout 3,433.5 pounds; average weight of all trout 3.4 pounds; average catch per angler 1.7; average catch per hour .37; average catch by weight per angler 5.8 pounds.

The Frog Lake (Nevada County) Fishery in 1948. Submitted March 7, 1949. 5 pp., 5 tables.

ABSTRACT: Discusses and summarizes the 1948 catch returns from this test lake. Catch records for 1938 through 1949 are tabulated. Practically negligible returns of a marked plant of 15,000 rainbow (2.5-13.0 per ounce) made in 1947 is discussed.

A Report on the Emigrant Basin Flow Maintenance and Stream Improvement Program (Wildlife Conservation Board Project No. 16). Submitted March 18, 1949. 74 pp., 16 sketch maps.

ABSTRACT: Describes, discusses and evaluates the nineteen individual retaining and check dam projects within the program. Lists additional information needed for some of the projects. Sketch maps of the project area are given for 16 of the projects. No cost estimates are given.

Report on Proposed Power Projects, Middle Fork Stanislaus River, Tuolumne County. Submitted September 28, 1949. 15 pp., 7 figures, 4 tables.

ABSTRACT: Gives description, present status, or probable effects on the fisheries of the proposed Beardsley and Donnells Dam projects on the Middle Fork Stanislaus River, Tuolumne County, applied for under Federal Power Commission Project Nos. 2005 and 2018 by the Oakdale and South San Joaquin Irrigation Districts. Recommendations for protection of the fisheries to be affected are given.

German, Eugene R.

Creel Census at McCloud River Mouth, Shasta County, May 1, 1949. Submitted May 15, 1949. 6 pp., including 3 tables.

ABSTRACT: The fifth annual creel census at the mouth of the McCloud River was conducted on May 1, 1949. Of 61 anglers, 11 fished the river and took 36 trout (mostly small rainbow), while 50 fished Shasta Lake and took 58 trout (larger rainbow, brown and Dolly Varden). There were more dollies than in other years. Angling was better than in 1948.

Aerial Fish Planting in District No. 1. Submitted October 31, 1949. 12 pp., including 2 tables.

ABSTRACT: Describes first full scale aerial fish plants and problems involved. Rough figures show planting costs per fingerling to be $0.004 by air and $0.02 by pack stock.

Creel Census at McCloud River Mouth, Shasta County, April 29, 1950. Submitted June 15, 1950. 3 pp., including 1 table.

ABSTRACT: The sixth annual creel census at the mouth of the McCloud River, on Shasta Lake, was made on April 29, 1950. 35 of 41 anglers fished the lake itself. Catch per hour from shore was .41 and by boat was .14. No fish over 14 inches were taken, but fish were in excellent condition. The catch consisted mainly of rainbow, only 2 Dolly Varden being taken.

Handley, John G.

Progress Report on a New Type of Fish Screen Tested in Trinity County. Submitted November 14, 1949. 9 pp., including 6 figures.

ABSTRACT: The history of the bar and rotary type fish screens is told briefly. The new perforated plate fish screen is described and its advantages given. Note is made of the importance of the by-pass flow. The tests made by Handley and Coots on the perforated plate screen on the Jim Lee Ditch, Trinity County, are described. These tests showed that during the 1949 irrigation season approximately 8,280 steelhead and salmon fingerlings were stopped by the screen, diverted through the by-pass opening, and carried back to the river.

Hanson, Harry A., and H. P. Chandler

Dispersing Rotenone at Morris Lake, Plumas County, California. Submitted February 10, 1949. 5 pp., including 1 map, 1 sketch of equipment and 1 photo of operation.

ABSTRACT: Report of method used to disperse 1,000 pounds cube root powder (4.9 percent rotenone content) in a forty-acre lake having a volume of approximately 750 acre-feet. Apparatus used: Two 10-foot light metal row boats, one used as a towboat and the other as a barge. Mixing was done in a 60-gallon oak barrel by means of a 2½ h.p. Lausen air-cooled outboard motor. Dispersion was by gravity through two one-inch garden hoses of 8- and 20-foot lengths. Rate of dispersion was about 200 pounds of powder per hour by two men. Suggested improvements in the method included by the authors.

Johnson, William C.

A Bottom Dredge for the Striped Bass Investigation. Submitted September 16, 1949. 7 pp., including 5 figures.

ABSTRACT: A bottom dredge was designed to survey shallow water areas where the standard tow net could not be used for the striped bass investigation. A description of the net and its construction is given in detail; dimensional drawings and photographs are also included.

Analysis of 1949 Striped Bass Party Boat Fishing Effort. Submitted June 14, 1950. 7 pp., including 1 table, 1 exhibit.

ABSTRACT: This is a routine report analyzing the fishing effort of the striped bass party boat operators during 1949. The analysis is made up from the daily logs the operators have submitted and other methods of contacting them for reports.

Kersnar, Frank J.

Chlorination of Crystal Lake. Submitted September 15, 1949. 21 pp., including 8 figures.

ABSTRACT: Crystal Lake was chlorinated in an effort to eradicate all aquatic life. Plan was to chlorinate so that residuals of 10 p.p.m. were obtained, but mechanical difficulties encountered prevented reaching this standard. Residuals slightly greater than 2.5 p.p.m. were obtained throughout the lake. Results achieved were good, although higher residuals would have given better results. Description given of apparatus and method used.

Kimsey, J. B.

Wildlife Conservation Board Project No. 49 FT(O), Tahoe National Forest Flow Maintenance and Improvement Program. Report of Surveys in 1949. Submitted March 20, 1950. 46 pp., including 4 maps, 8 photos, 2 tables, and appendix.

ABSTRACT: Report of surveys made in 1949. Five units listed, two unsatisfactory. Unit 1. Two check dams proposed. Dams on three other lakes tentatively recommended pending work in 1950. Unit 2. Chemical treatment of lakes—not recommended. Unit 3. Barrier removal on south fork Yuba River, Nevada County. Recommended removal three impassable falls in first two miles of stream. Unit 4. Chemical treatment of lakes—not recommended. Unit 6. Retained dams recommended on Lower and Middle Loch Leven Lakes.

Chemical Treatment of Miller Lake, Placer County, August 21, 1949. Submitted March 27, 1950. 4 pp. plus map, 2 photos, blueprint.

ABSTRACT: A description of the lake, its fishery and past stocking is given. The survey and subsequent chemical treatment is described. The treatment appears to have been successful and thousands of suckers and only one large brown trout were removed. A barrier dam was designed and constructed to prevent entry of rough fish from outlet waters. The lake will be restocked in 1950 with 15,000 rainbow trout.

Chemical Treatment of Richardson Lake, El Dorado County, August 20, 1949. Submitted March 27, 1950. 4 pp. plus map, 2 photos, blueprint.

ABSTRACT: A description of the lake, its past stocking and fishery is given. The chemical treatment was successful with thousands of introduced minnows and suckers being killed and only one eastern brook and one rainbow trout killed. A barrier dam to prevent rough fish migrations into the lake was designed and constructed. The lake will be restocked in 1950 with 8,000 eastern brook trout.

Notes on Kokanee (*Oncorhynchus nerka kennerlyi*) spawning in Donner Lake, Nevada County, 1949. Submitted June 30, 1950. 18 pp., including 6 figures.

ABSTRACT: Spawning Kokanee and their nests were observed periodically from November, 1949, to February, 1950. Drawdown of lake by power and irrigation companies exposed nests. Most of eggs were killed by prolonged freezing. Some eggs which were frozen for only short periods continued development as did eggs in seepage areas. It appears successful natural reproduction of Kokanee in Donner Lake is possible, providing water levels can be manipulated reasonably. Discussion of possible remedies, including moving gravels into deeper water.

Miller, Richard G.

A Study of the Food of Lake Tahoe Fishes. Progress Report: 1948. Submitted April 29, 1949. 27 pp., including 11 tables and 2 figures.

ABSTRACT: Summarizes findings of first half of proposed two-year program investigating ecology of Lake Tahoe fishes. Lists 10 species present, with lake chub and sculpin as principally utilized forage fishes, whitefish and sucker as incidental

forage, and red-sided shiner and speckled dace as unutilized. Tables of stomach sample analyses given for 8 species, including mackinaw trout, the principal predaceous fish. Interrelationships noted include: rainbow-mackinaw, cutthroat-mackinaw, brown trout-forage species. Historical account of fishery summarizes possible causes for disappearance of Lake Tahoe cutthroat. Natural reproduction appears to be perpetuating mackinaw and brown trout in the lake. Appendix (pp. 23-27) partially discusses effects of season, wind, and temperature, with thermoclines of two stations graphed. Table A (p. 25) breaks down the total sport catch logged at one station (2,947 pounds for 131 days) into monthly data for mackinaw, rainbow, and brown trout, including: average weight per fish (4.25 pounds), average number catches per day, and average number fish caught per day (5.4). Conclusions expressed are tentative, pending final report. Bibliography of 9 titles.

Outline of Work to Be Done on the Food Habits of the Forage Fishes of Lake Tahoe in 1949. Submitted April 29, 1949. 8 pp.

ABSTRACT: Proposed study of Lake Tahoe ecology, with special emphasis on food relationships of 5 species of forage fishes, is intended to reveal the kinds of organisms utilized and their volumes. Seven sections outline the methods and procedures for sampling, size of samples, location of sample stations, and supplemental observations proposed for determining: (1) food habits of 5 species of fish at 3 stations (by statistical analyses of stomachs), (2) seasonal dietary change, (3) food habits of various sizes of a species, (4) diurnal variation in feeding and (5) interrelationships. Appendix lists equipment needed, its source, and estimated cost.

Murphy, Garth I.

Experiments on the Tolerance of Sacramento Perch to Copper Sulphate. Submitted November 29, 1948. 3 pp.

ABSTRACT: A series of aquarium experiments indicate that Sacramento Perch (*Archoplites interruptus*) can stand copper sulphate in quantities up to 0.5 p.p.m. in Clear Lake, Lake County, water (pH 7.8-8.1, total alkalinity 16 p.p.m.).

The 1947 and 1948 Fishery of Conn Valley Reservoir, Napa County. Submitted January 11, 1949. 23 pp.

ABSTRACT: Conn Valley Reservoir, constructed in 1945, has a depth of 110 feet and a surface area of 950 acres when full. Ecological conditions in the lake are borderline for rainbow trout. Rainbow trout and green sunfish are the principal constituents of the lake population. In 1947, the catch consisted of 30 percent hatchery trout planted at 25 to the ounce in April, 1945, and 70 percent wild trout. In 1948, the catch was 96 percent catchable trout planted in March, 1948, and 4 percent wild trout. Factors responsible for the lack of wild trout in the 1948 catch, and recommendations for future management and research, are discussed.

The 1948 Fishery of Clear Lake, Lake County. Submitted February 17, 1949. 13 pp., Appendix A, 2 figures.

ABSTRACT: In 1948, the catfishery was about one-third better than in 1947 in terms of catch per angler by number, apparently through the appearance of a stronger year class (1947) in the fishery. A good forage fish crop was produced in 1948 and probably because of this survival of young bass, Sacramento perch, and catfish to the early fall was exceptionally good. The outlook for an improving fishery at Clear Lake is good.

Fish tagging. Submitted March 16, 1950. 26 p.

ABSTRACT: This report is an annotated partial survey of the literature on fish tagging. 110 papers are cited.

Fish rescue and stream improvement work in the North Coast Area in 1949. Submitted April 15, 1950. pp. 1-2, 7 tables.

ABSTRACT: In 1949 4 fish rescue crews were in operation. One was stationed at Prairie Creek Hatchery, one in Humboldt County, and two in Mendocino County. One of the Mendocino County crews was financed by Mendocino County. The four crews combined rescued 783,313 trout and salmon.

Returns from marked fall spawning rainbow trout planted in several Mendocino County coastal streams in 1948. Submitted May 12, 1950. pp. 1-6, 4 tables.

ABSTRACT: 50,000 rainbow trout were planted in 9 streams, at approximately 6,000 to a stream. Plants were made in September and October. No serious effort was made to obtain returns. Spot checks and reports from wardens and sportsmen recorded 8 of the marked fish in angler's catches in 1949. Reasons for the poor returns are discussed.

Shapovalov, Leo

Fish rescue and stream improvement work in the North Coast Area in 1945. Submitted June 7, 1949. 11 pp., including 6 tables.

ABSTRACT: In 1945, 2 State fish rescue crews operated 173 man-days from May 8 through October 26 and rescued 842,206 trout and salmon in Del Norte, Mendocino, and Lake Counties. These fish weighed 34,872 ounces and averaged 24.2 fish per ounce. They were planted in streams and lakes in Del Norte, Mendocino, Lake, Napa, and Sonoma Counties. On the basis of 1945 Prairie Creek Hatchery costs, the total cost of producing and planting the rescued fish at a hatchery would have been $4,588.74.

Fish rescue and stream improvement work in the North Coast Area in 1946. Submitted June 10, 1949. 12 pp., including 6 tables.

ABSTRACT: In 1946, State fish rescue crews operated 206 man-days from May 2 through October 3 and rescued 981,544 trout and salmon in Del Norte, Mendocino, and Lake Counties. This is the largest number taken in any season in this area. These fish weighed 38,719 ounces and averaged 24.4 fish per ounce. They were planted in streams and lakes in Del Norte, Mendocino, Lake, and Sonoma Counties. On the basis of 1946 Prairie Creek Hatchery costs, the total cost of producing and planting the rescued fish at a hatchery would have been $7,326.75.

Fish rescue and stream improvement work in the North Coast Area in 1948. Submitted April 7, 1950. 14 pp., including 9 tables and appendices.

ABSTRACT: In 1948, State crews rescued 326,626 trout and salmon and the Mendocino County crew 108,750, a total of 435,376, in Del Norte, Humboldt, Mendocino, and Lake Counties. The fish were planted in various streams and lakes in these counties. The State crews operated a total of 132 man-days, from May 17 through September 29. The combined fish rescues weighed 35,309 ounces and averaged 12.3 fish per ounce. On the basis of 1948 Prairie Creek Hatchery costs, the total cost of producing and planting the rescued fish at a hatchery would have been $12,578.76. A limited amount of stream improvement work, mostly of an annual nature, was also done by the Upper Eel River crew.

Fish rescue and stream improvement work in the North Coast Area in 1947. Submitted April 3, 1950. 15 pp., including 10 tables and appendices.

ABSTRACT: In 1947, State fish rescue crews operated 206 man-days from May 16 through August 2 and rescued 381,700 trout and salmon in Del Norte, Mendocino, and Lake Counties. These fish weighed 12,276 ounces and averaged 31.1 fish per ounce. They were planted in streams and lakes in Del Norte, Mendocino, Lake, and Sonoma Counties. On the basis of 1947 Prairie Creek Hatchery costs, the total cost of producing and planting the rescued fish at a hatchery would have been $2,345.80. A considerable amount of stream improvement work, mostly of an annual nature, was also done by two of the crews. Trout and salmon rescue operations in Napa, Santa Clara, and Santa Cruz Counties are included in the appendices.

Soule, Scott M.

Power development in Kings River drainage, Fresno County, California. Report Number 1: General description. Submitted May 27, 1949. 1 plus 21 pp., including 1 figure.

ABSTRACT: Describes Kings River drainage, water supply, existing irrigation and power developments, access roads and trails, and recreational development and potentialities. Upstream power development—long delayed because of interference with downstream irrigation rights—is now possible through reregulation of river flow by new Pine Flat Reservoir. Gives a brief account of present development plans proposed by Pacific Gas and Electric Company, Fresno Irrigation District, Francis N. Dlouhy, City of Los Angeles, and U. S. Bureau of Reclamation, and describes the fishery threatened thereby. A summary of pertinent correspondence and reference literature together with a table showing partial recreational use is appended.

Creel census at Hume Lake, Fresno County, May 1, 1949. Submitted May 27, 1949. 11 plus 22 pp., including 5 figures and 6 tables.

ABSTRACT: Gives a brief description of Hume Lake (surface area, 94 acres) and its past fishery, including 1940 and 1947 poisonings and summary of stocking since 1940. Out of 914 anglers checked out between 7 a.m. and 8 p.m. on only road leaving lake, completed records were obtained for 886, who caught 4,939 trout, 4,931 rainbow and 8 brown, for an average of 5.46 trout per fisherman-day or an average of 0.75 trout per fisherman-hour. The rainbow trout averaged 8½ inches fork length. 10.7 percent of all anglers made limit catches (15 trout); 17.4 percent made zero

catches. About 60 percent of total anglers fished from shore and accounted for 49 percent of total catch, as against 40 percent who fished from boats and made 51 percent of total catch. Estimated total number of anglers was 1,044 and total catch was 5,683 trout. Recommends further creel studies at Hume Lake and a comparative study of Hume and Sequoia Lakes, stocked with spring and fall spawn stock rainbow respectively.

Power development of Kings River drainage, Fresno County, California. Report Number 2: North Fork of Kings River. Submitted October 21, 1949, viii plus 56 pp., including 19 figures and 3 tables.

ABSTRACT: Describes the North Fork Kings River, its present trout fishery and power development. Lists the proposed power developments as planned by Pacific Gas and Electric Company, Fresno Irrigation District, and the U. S. Bureau of Reclamation. Discusses the probable effect of these developments on the fishery. Concludes that the fishery can be partially saved by water releases of between 3 and 4 percent of the mean annual flow of the river, or that it could be replaced in kind by improving or creating other fishing waters at the expense of the agency developing the power resources and that the fishery should be saved by one of these two means. Recommends that the Division of Fish and Game notify all interested agencies of the threatened loss of fisheries value and negotiate to save the fishery by obtaining water releases or by a replacement of the fisheries value to be lost by having agency developing power improve other waters.

Occasional creel censuses at Hume Lake, Fresno County, during 1949. Submitted April 7, 1950. 1 plus 31 pp., including 14 tables.

ABSTRACT: Describes Hume Lake (94 acres) briefly; gives summary of stocking since 1947 (i.e. after last poisoning). Results of 8 creel checks show fishing good early May but poor late May through mid-September, then picked up to fair by season's close (October 31). The estimated total season's catch was 17,000 rainbow trout, by an estimated 7,000 angler-days of fishing (estimated average catch/day of 2.4 and estimated average catch/hour of 0.51). Season's pressure estimated at 74 anglers/acre; season's catch estimated at 180 rainbow trout/acre. Angling pressure, catch and stocking data are compared with same for Castle, Crystal, and June Lakes. Concludes that nearly all of the 1949 catch was of planted rainbow trout and discusses their age, growth and condition. Estimated about 75 percent of basic annual plant (30,000 spring-spawn rainbow trout at 4½ inches in September) was harvested in 1949, and on basis of estimated $35/M planting cost, each creeled rainbow trout cost slightly over 6 cents. Recommend continuation of present basic stocking policy and trial planting of 10,000 catchable rainbow trout spaced during summer. Concludes that unless trial planting of catchable rainbow trout succeeds, there is little hope of raising the quality of angling during mid-season months when the lake temperature attains or exceeds 70 degrees F. Recommends further O_2 and temperature studies and investigation of success of spawning in tributary streams.

Soule, Scott M. and William A. Dill

Pine Flat Reservoir, Fresno County. Submitted July 12, 1949. 15 pp. plus 1 table and 1 plate.

ABSTRACT: Chronological summary of all developments re permits and protests on Corps of Engineer's Flood Control Project on Kings River near Piedra. Describes: river and fishery in project area; projected dam, reservoir and its operation; effect on fishery. Dam will store 1 million acre-feet with surface area of 5,900 acres. Fluctuation may be 393 feet annually, and no provision is made for dead storage. Report gives recommendations for minimum pools, impoundments outside reservoir area if minimum pools are not provided, construction of borrow pits to provide fishing ponds, screens, minimum flows below dam. Suggests these recommendations be put into form of a resolution by California Fish and Game Commission.

Vestal, Elden H.

The creel census at Rush Creek Test Stream, Mono County, California, season of 1948. Submitted November 30, 1948. 15 pp., 5 tables, 2 figures, 1 photo.

ABSTRACT: The creel project at Rush Creek was operated for a total of 169 fishing days. All plantings were doubled over 1947 and a 3-day post-planting closure following each catchable plant was tried. From April 28 to August 11, 1948, 19,945 rainbow trout averaging 7 inches long (marked right ventral) were planted. (5 spaced plants each of about 4,000 rainbows were made). On October 13, 1948, the second winter carryover plant of 8,000 rainbows (average 4½ inches) was made; as in 1947 these plants were made in two groups of 4,000 each: fall-spawned from

1947 eggs (marked dorsal and adipose) and spring-spawned from 1948 eggs (marked adipose). In addition, two 1948 summer plants of fingerling brown trout (4,000) and rainbow trout (4,000) were made for an additional carryover test. During the 1948 season, 8,384 anglers fished 31,962 hours for a total of 20,379 wild and planted fish. Marked hatchery fish contributed 93.6 percent of total catch. Out of the 19,945 catchable rainbow trout planted, 18,362 (92.1 percent) were caught. Only 72 (3.8 percent) of the fall-spawned 1947 carryover plant and 175 (8.8 percent) of the spring-spawned 1947 carryover plant showed in 1948 creels. No 1947 carryover fish were taken after August 14. Wild fish contributed 6.4 percent of total 1948 catch: 1,131 (87.6 percent) were brown trout, 140 (10.8 percent) were rainbow trout, and 21 (1.6 percent) were eastern brook. Average angler catch per hour for the season was 0.63. Sixty percent of the right ventral fish were taken in only 20 fishing days (4-day samplings following the post-planting closures).

Additional treatment of aquatic plant beds at Twin Lakes, Mammoth, Mono County, California. Submitted December 28, 1948. 6 pp., 1 figure.

ABSTRACT: An area of 2.8 acres between center and lower Twin Lakes, in the Mammoth Lake Recreation Area, choked by dense growths of chiefly *Anacharis*, was treated with 885 pounds of sodium arsenite powder (75 percent arsenious oxide) giving an initial concentration of 21.2 p.p.m. arsenious oxide; partial collapse and a "burn" of plant growth down to a depth of 6 inches was observed a week later. The high concentration used forms a test of sodium arsenite in a disturbed water situation where wave action, stream flow, and ground seepages might easily nullify caustic action of the poison at lower concentration. Control of plants in the interlake area will restore the area to angling, interlake boat travel, and to recreational use of hundreds of vacationers using the Twin Lakes camp grounds.

Creel inventory at Rush Creek Test Stream, Mono County, California, 1949. Submitted December 19, 1949. 13 pp., 2 figures, 4 tables.

ABSTRACT: The creel inventory was conducted for 179 fishing days. From April 29 to August 29, 19,975 rainbow trout averaging 7½ inches long (marked VV) were planted at six intervals. Two special summer plants of fingerling browns (3,003) and rainbow (3,000) were made for a further carryover test. During the 1949 season, 10,004 anglers fished 36,417 hours for a total of 18,020 wild and planted fish. Marked hatchery fish contributed 90.8 percent of the total. Out of 19,975 catchable rainbow (marked VV) planted, 15,995 (80.0 percent) were taken. Only 54 of the fall-spawned 1948 carryover plant and 114 of the spring-spawned 1948 carryover plant (2.2 percent combined) were taken in 1949 creels. Wild fish contributed 9.2 percent of the 1949 total catch; 1,373 (83.0 perecent) were brown, 279 (16.7 percent) were rainbow and 5 (0.3 percent) were eastern brook. Average catch per angler hour for the season was 0.49 with the catch per angler day at 1.8.

Chemical treatment of Upper Twin Lake, Robinson Creek, Mono County, California. Submitted April 15, 1950. 41 pp., including 14 figures, 9 photos, 3 maps, 6 tables, 2 graphs.

ABSTRACT: Upper Twin Lake, Robinson Creek, Mono County, 14 miles southwest of Bridgeport, was treated September 8, 1949, with 16,835 pounds of cube, rotenone averaging about 5 percent, to remove a large population of chubs, sandbar suckers, shiners, and sculpins. The lake at spill has 265 surface acres with a maximum depth of 112 feet; maximum temperature is 65° F., and there is unusually high oxygen deep into the hypolimnion. Plan of the project is described and embodied in Figure 5, p. 8A. Only 194 trout were reported from the lake, while over 100,000 rough fish were killed. End concentration of cube used was approximately 0.68 p.p.m.; 15,200 pounds of cube was used in lake treatment and 1,635 pounds in treatment of about 4 miles of tributaries. Spill from the lake was nontoxic to trout and whitefish 75 days after treatment. Restocking and proposed management program is discussed and recommendations presented.

Chemical treatment of Tamarack Lake, Mono County, California, 1949. Submitted January 26, 1950. 8 pp., 2 figures.

ABSTRACT: Tamarack Lake, 12.7 acres at an elevation of 9,700 feet near Bridgeport, Mono County, California, was infested with sand-bar suckers (*Catostomus arenarius*), introduced about 1879 by pioneers of the Bridgeport Valley as forage for trout in the lake. Elimination of the sucker population was accomplished September 21-23, 1949, with 535 pounds of cube (rotenone 3.9 percent) as a necessary step in preparation for the proposed chemical treatment of Lower Twin Lake as well as for restoration of Tamarack Lake as a trout water.

Vestal, Elden H. and Ralph V. Beck

Preliminary report on the proposed chemical reclamation of Bridgeport Reservoir, Mono County, California. Submitted August 23, 1948. 14 pp., 1 figure.

ABSTRACT: The Bridgeport Reservoir, of the Walker River Irrigation District, is located near Bridgeport, Mono County. It has a capacity at spill of 42,460 acre-feet with a surface area of 3,070 acres and maximum depth of about 49 feet. The reservoir at one time produced reasonably good trout fishing, but since about 1934 has become overrun with carp. Exceptionally dry seasons of 1947-48 have created the first opportunity for carp removal from the reservoir and tributaries in 15 years; and feasibility for the project is expected by late September or early October this year. The method of continuous distribution of rotenone at 1 p.p.m. in the tributaries with backpump treatment of nonflowing "pockets" is outlined. Treatment of the reservoir will follow methods used at Gull Lake, with a concentration of rotenone of 1 p.p.m. Fish rescue is not considered practical and it is desired that dead fish be left to refertilize the reservoir. It is recommended that 200,000 brown trout fingerlings be used to restore the sport fishery.

Report on the stream-use census at Rock Creek, Inyo and Mono Counties, California, 1948. Submitted December 17, 1948. 22 pp., 1 figure, 4 tables, 1 graph.

ABSTRACT: A stream-use census was conducted over chiefly 6.3 miles of Rock Creek during the entire 1948 angling season of 184 days. The project was in support of a protest by the Division of Fish and Game against application of the City of Los Angeles to divert 50 c.f.s. and 40,000 acre-feet from a point 0.9 miles above Tom's Place, Mono County. Special car samples totaling 120 in June, July, and August showed an average of 2.86 persons per car, of which 73.2 percent were anglers. Some 14,114 cars were recorded in the project area in 1948; the total number of recreational days was estimated at 40,366, indicating an estimated 29,548 angler days in the 6.3 miles during the season. Average daily use per mile per day was about 25.4 anglers. Angler use was greatest in July with 9,851 angler days (50.4 per mile per day) and least in October with 2,037 angler days (10.4 per mile per day). Assuming a cost per angler of 20 dollars, the 6.3 miles of stream were valued at $590,960 in 1948 to fishermen. Possible developments for the future in Rock Creek Gorge might provide for 9,347 more angler days. The 1948 creel count showed that 3,963 anglers fished 6,119 hours for a total of 11,956 trout; 9,956 (83.2 percent) were rainbow trout, 2,004 (16.7 percent) were brown trout, and 5 (0.04 percent) were eastern brook. Zero catches totaled 990 (32.5 percent). Average catch per angler per day was 3.0 and average catch per angler per hour was 1.9.

Vestal, Elden H. and Leon A. Talbott

Aerial fish-planting in the High Sierra, Season of 1949. Submitted March 7, 1950. 16 pp., including 2 tables.

ABSTRACT: A report of the first large-scale airplane fish planting in the High Sierra Region of California, July 20 to 29, 1949. Includes tabulation and discussion of a series of practical fish-planting tests at Virginia Lakes, Mono County, as well as a detailed list (Table 2) of all plants made. Estimated cost of the planting work is discussed. A summary of the planting is provided on page 11.

Wales, J. H.

Some thoughts on trout management. Submitted May 27, 1949. 16 pp., including 2 figures.

ABSTRACT: Ideas are expressed regarding: 1. Improvement of environment. 2. Reduction of predation. 3. Introduction of new species. 4. Planting of native species.

Creel census, May 1, 1949, Shasta River, Siskiyou County. Submitted May 31, 1949. 3 pp., including 2 tables.

ABSTRACT: Second annual creel census of angling in a section of Shasta River from highway 99 crossing near Yreka downstream. Anglers checked—36. Catch 140 fish or 3.9 per angler day. All immature steelhead, average length 7.1 inches.

Klamath River fish count, Klamathon Racks. Submitted February 23, 1950. 11 pp., including 2 tables and 1 figure.

ABSTRACT: The racks were placed in the Klamath River on August 15 and removed on November 17, 1949. During this period 11,212 king salmon, 541 silver salmon, and 2,836 steelhead adults were counted through on their spawning migration upstream. This is the first year that a complete count of the silver salmon has

been kept. Since 1925 there have been 16 years in which the king salmon have been counted. The average annual count for this period is 12,068. An electric eye counting device was tested and found reasonably successful. It is recommended that next year the racks be left in the river until the silver salmon run is completed and longer if possible.

Shasta River fish count, Siskiyou County, 1949-50. Submitted March 10, 1950. 4 pp., including 2 tables.

ABSTRACT: The Shasta River counting station was put in operation on September 15 and was maintained until January 19, when high water caused a rotten timber to give way and several sections of the racks were washed away. The first king salmon passed through the racks on September 28, the last October 14; total king salmon count was 193. The first silver salmon was counted on October 24, the last on December 20; total 312. The first steelhead appeared on October 3 and to the time the racks washed out 491 fish were counted through; probably the greatest part of the run occurred after this. It is recommended that if a new station can be established before September, 1950 the present station be abandoned; if this cannot be done the present station should be used to count the king salmon run only.

Creel census, Shasta River, Siskiyou County, April 29, 1950. Submitted June 8, 1950. 6 pp., including 3 tables.

ABSTRACT: On the opening day of the 1950 fishing season a creel census was made on the lower 7 miles of the Shasta River. 48 anglers were interviewed and 63 fish measured. 109 anglers were counted and 200 estimated to have fished the section on the opening day. The estimated catch per day was 11.5 and the catch per hour was 4.35. All fish seen were immature steelhead ranging in length from 4.5 to 9.5 inches, with an average of 7.0 inches. Rough estimates of the pressure on this section of the river indicate that while fishing lasted (April 29-May 21) the total catch in this section was 8,500 fish, largely 2-year old steelhead.

Sacramento River Experimental Stream, 1949 report. Submitted May 22, 1950. 21 pp., 11 tables.

ABSTRACT: Results of the creel census on the South and Middle Forks of the Sacramento River and on 14 lakes and 2 tributary streams are reported. Results of shocking experiments on the South Fork are given. Following is a brief summary for the 2 forks: South Fork—439 anglers; 2,581 total catch; catch per hour 2.59; wild rainbow trout 2,077; hatchery rainbow trout 470; eastern brook 14. Middle Fork—179 anglers; 1,555 total catch; catch per hour 2.55; wild rainbow trout 1,184; hatchery rainbow trout 371.

Pine Creek Basin, Modoc County, Stream Improvement Project. Submitted June 16, 1950. 4 pp.

ABSTRACT: Recommendations are made for lake and stream improvement in Pine Creek Basin, Modoc County. The following projects are recommended:

1. A rock and dirt fill dam to form a 15-acre lake in Pine Basin meadow.
2. A rock and dirt fill dam to deepen a small lake already in existence.
3. Several small dams to form pools in Pine Creek itself. Up to 10 such small dams could be constructed.

Wales, J. H., and M. Coots

Creel census, May 1, 1949. Klamath River, Siskiyou County. Submitted June 6, 1949. 3 pp.

ABSTRACT: The Klamath River was checked on opening day from Copco to Humboldt line, a distance of 134 miles. Anglers counted, 357. Estimated catch 5 fish per angler or 1,785 fish. All immature steelhead, average length 7.0 inches.

Wales, J. H., and E. R. German

Castle Lake trout investigation, 1949 season. Second phase: Eastern brook trout. Submitted May 16, 1950. 23 pp., including 20 tables.

ABSTRACT: Catch for 1949 was 4,928 trout in 1,067 angler days; 4.6 fish per day; 1.78 fish per hour. Of yearling eastern brook planted in 1947, 48 percent had been caught by end of 1949 season. Of fingerling eastern brook planted in 1947, 21 percent had been taken by end of 1949 season. Of the eastern brook fingerlings planted in 1948, significantly more were caught with mark of LV and Ad than of Ad mark alone. High survival of plants has caused reduction in food and in growth. Fingerling plant after two years in lake averages only 6.7 inches.

Castle Lake trout investigations—Report for 1948. Second phase: Eastern brook trout. (Siskiyou County). Submitted May 24, 1949. 19 pp., including 20 tables.

ABSTRACT: Anglers' catch for 1948 was 5,199 eastern brook trout by 1,213 anglers for an average of 4.3 per day and 1.36 per angler hour. Two year groups were represented. Up to the end of the 1948 season 46 percent of the 1947 yearling plant had been caught and 8.9 percent of the 1947 fingerling plant. 28 percent of the angler days resulted in zero catches. The largest were continually being caught so that no large fish ever developed. There was a large movement out of the lake with the overflow in the fall. 1,653 fish went down the outlet stream in November. Growth rate was relatively slow, slower than in the Mt. Shasta Hatchery. The C. F. was only medium, the lake may be slightly overcrowded. Plankton seemed to be returning after having been killed out by rotenone. Pounds of bottom food was estimated at 149 per acre.

Sacramento River Test Stream report for 1948. Submitted July 22, 1949. 17 pp., 5 figures.

ABSTRACT: Results of the creel census on the South and Middle Forks of the Sacramento River and on 15 lakes of this basin are reported. Following is a brief summary for the 2 forks: South Fork—564 anglers; 2,500 total catch; catch per hour 1.44; wild rainbow 1,749; hatchery rainbow 696; eastern brook 54; brown 1. Middle Fork—122 anglers; 839 total catch; catch per hour 2.40, wild rainbow 698, hatchery rainbow 140; eastern brook 1.

Warren, Charles E. (Student Biologist)

The extent and effect of pollution resulting from the Modesto Sewage Farm Levee Break. Submitted August 30, 1949. 12 pp., including 5 figures and 3 tables.

ABSTRACT: A break occurred in a levee at the Modesto sewage farm on August 21, 1949. This report covers an investigation of the extent and effect of damage done as a result of the sewage break. Through oxygen depletion much fish life was destroyed in the Tuolumne River and down the San Joaquin River to Salmon Slough. Here the main pollution passed into Salmon Slough, dissipating itself about seven or eight miles below its mouth. Damage was inflicted on most species present, but the loss of fork-tailed catfish was probably most important. The damage to the sport fishery on this fish alone was estimated at $135,000.

Woodhull, Chester

Observations on handling the sampling gill net. Submitted May 19, 1949. 8 pp., 5 figures.

ABSTRACT: Observations on methods for easy handling of the sampling gill nets are noted. Directions are included for the construction. A gill net rack that facilitates laying and hauling of the nets, especially for one man operation. Four photos illustrate operation of the net and rack.

REPORT OF THE BUREAU OF PATROL AND LAW ENFORCEMENT

The number of employees remained about the same as in the previous biennium. Promotional and open examinations were held for wardens, and as a result, some 30 assistant wardens were advanced to warden positions. Further appointments of wardens authorized in the present fiscal year from the open list created will be reflected in the next biennial report.

Promotional examinations to fill captain vacancies created by various causes were also held. These appointments will be made in the 1950-51 Fiscal Year.

The personnel of the bureau as of June 30, 1950, was as follows:

1	Chief of patrol
6	Assistant chiefs of patrol
10	Land captains
2	Marine captains
2	Captains, fish patrol boat
173	Wardens and assistant wardens
2	Warden pilots
2	Senior stenographer-clerks
1	Intermediate stenographer-clerk
2	Intermediate clerks
1	Master, fisheries vessel
1	Motor vessel engineman
2	Assistant motor vessel enginemen
4	Deckhands, fish patrol boat
1	Ship's cook

No change in the general administrative program was made during the present biennium. For patrol purposes, the State is divided into five land districts and one marine district, with headquarters at San Francisco, Redding, Sacramento, Fresno, Los Angeles and Terminal Island, each in charge of an Assistant Chief of Patrol.

The Wardens' Reserve Force was increased during the period. A unit was established in the San Francisco area, another in the Fresno district. Appointments are made only after thorough training, the applicant being required to attend a course of instruction in law enforcement technique one night a week for a period of eight or ten weeks, after which he must pass a satisfactory examination before being eligible for appointment.

These units select their own captains and squad leaders. The leaders are held strictly responsible for the conduct of their men to the local patrol headquarters. They furnish their own uniforms and equipment, and are instructed to work closely with the regular warden in the district.

These men have exhibited none of the selfish characteristics of some of the old-time volunteer badge-holders, and are always willing to set aside their personal desires to hunt and fish in order to assist the regular warden in his duties of protecting fish and game.

No training schools were held for the regular patrol force during the period of this report. Most of the men had this training in previous classes. It is intended that a school will be set up early in 1951.

Six small power boats for patrol activities were acquired during the period of this report, some being replacement units for boats which were surveyed because of age and obsolescence. A 36-foot steel boat was built for San Francisco Bay patrol. This proved to be unsatisfactory for patrol work, and was transferred to the Bureau of Marine Fisheries for use in coastal research work.

The two 63-foot A. C. R. boats purchased during the previous biennium, equipped with radar, have proved most successful in patrolling Southern California waters. Negotiations are now under way to acquire

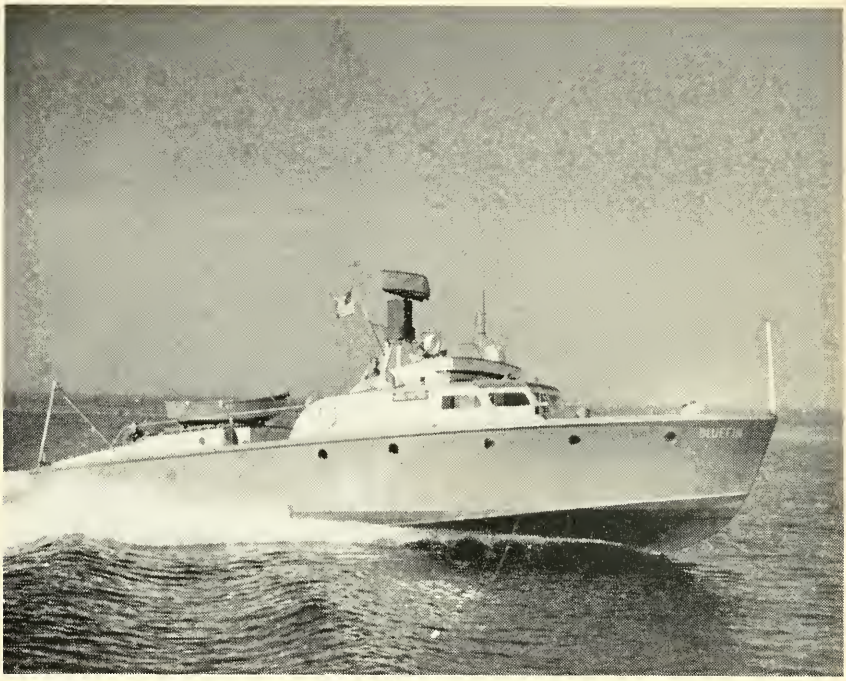

FIGURE 20. 63-foot Fish and Game patrol boat BLUEFIN. The commission operates two of these vessels in Southern California waters. Equipped with two 630-h.p. Hall Scott Defender engines, radar, radio and full marine equipment. *Photograph by Vernon M. Haden, San Pedro.*

another vessel of this type to cover San Francisco Bay and ocean waters adjacent as far south as Monterey. The next fiscal year's budget provides for this purchase.

Considerable progress is being made with car and boat radio communications for the warden service. A number of areas in the State which in the past have not had this type of communications are operating satisfactorily with either county sheriff's installations or state facilities. In many instances the counties furnish the equipment.

We had hoped to report that arrests and convictions for the biennium would have decreased over the previous period, but this is not the case.

Total arrests for the biennium were 12,947, an increase of 1,616 over the previous like period. The average fine was over $43, a slight increase over the last biennium. A survey of arrests and fines throughout the Nation indicates the average fine to be $21 for fish and game law violations. The commission and the bureau at this time wish to thank the California courts for their cooperation in assessing penalties more than twice the general average for the Nation.

It will be noted that the arrests, fines and forfeitures were considerably higher during the first fiscal year than in the second fiscal year of this report; however, the jail sentences were more than two and one-half times greater in the second fiscal year than in the first.

A recapitulation of arrests, fines and seizures will be found in Appendix E.

APPENDICES

APPENDIX A

STATEMENTS OF REVENUE AND EXPENDITURE

STATEMENT OF REVENUE

For the Period July 1, 1948, to June 30, 1949

One Hundredth Fiscal Year

Revenue for fish and game preservation fund	Detail	Total
1949 series		
Angling	$1,699,074.35	
Hunting	64.00	
Deer tags	15.00	
Fish tags	6,337.75	
Game tags	165.15	
Market fisherman	73,300.00	
Fish importer	80.00	
Fish party boat permits	647.00	
Fish breeder	535.00	
Game breeder	2,865.00	
Kelp license	30.00	
Game management area license	330.00	
Game management area tags	.54	
Salmon tags	48.00	
Total 1949 series		$1,783,491.79
1948 series		
Angling	$1,445,847.55	
Hunting	1,497,107.10	
Archery-resident	1,956.00	
Archery-nonresident	25.00	
Commercial hunting club	700.00	
Commercial hunting club operator	230.00	
Trapping	1,272.00	
Fish packer and shellfish dealers	16,265.00	
Archery-deer tags	734.00	
Deer tags	300,313.00	
Fish tags	3,981.24	
Game tags	438.12	
Market fisherman	69,080.00	
Fish importer	10.00	
Fish party boat permits	184.00	
Fish breeder	60.00	
Game breeder	375.00	
Game management area licenses	120.00	
Game management area tags	367.83	
Salmon tags	146.94	
Deer meat agents—locker permits	10,600.50	
Deer meat agents—Wardens	937.00	
Waterfowl permits	3,198.00	
Total 1948 series		3,353,948.28
1947 series		
Angling		
Debit	$59.00	
Hunting	958.50	
Archery-deer tags		
Debit	10.00	
Total 1947 series		889.50
Total license revenue		$5,138,329.57

STATEMENT OF REVENUE—Continued

For the Period July 1, 1948, to June 30, 1949

One Hundredth Fiscal Year

Revenue for fish and game preservation fund	Detail	Total
Other revenue		
Fish packers tax	$166,737.41	
Sardine tax	87,991.07	
Kelp tax revenue	2,236.50	
Lease of kelp beds	998.10	
Salmon tax	52,084.03	
Confiscated fish	61,556.86	
Miscellaneous revenue—undetermined	24,138.30	
Miscellaneous revenue	43,111.84	
Court fines	177,273.30	
Interest on surplus money investment fund	23,198.64	
Total other revenue		$639,336.15
Total Fish and Game Preservation Fund		$5,777,665.62
Less: License Commissions		248,618.97
Net fish and game preservation fund revenue		$5,529,046.65

STATEMENT OF REVENUE—Continued

For the Period July 1, 1949, to June 30, 1950

One Hundred and First Fiscal Year

Revenue for fish and game preservation fund	Detail	Total
1950 series		
Angling	$1,712,956.00	
Hunting	83.00	
Trapping	2.00	
Fish packers and shell fish dealers	570.00	
Deer tags	3.00	
Fish tags	10,332.15	
Game tags	121.80	
Market fishermen	80,560.00	
Fish importers	85.00	
Fish party boat permits	780.00	
Fish breeders	760.00	
Game breeders	3,465.00	
Kelp license	20.00	
Game management area licenses	460.00	
Game management area tags	14.85	
Salmon tags	160.00	
Total 1950 series		$1,810,372.80
1949 series		
Angling	$1,326,234.85	
Hunting	1,451,298.03	
Archery-resident	2,625.00	
Archery-nonresident	65.00	
Commercial hunting club	750.00	
Commercial hunting club operator	215.00	
Trapping	1,176.00	
Fish packers and shell fish dealers	2,515.00	
Archery deer tags	882.00	
Fish tags	6,535.50	
Game tags	479.76	
Deer tags	308,773.00	
Alien nonresident deer tags	9,910.00	
Market fishermen	76,370.00	
Fish importers	5.00	
Fish party boat permits	170.00	
Fish breeder	110.00	
Game breeder	505.00	
Kelp license	10.00	
Game management area licenses	90.00	
Game management area tags	518.58	
Antelope permits	3,500.00	
Salmon tags	37.51	
Pheasant tags	170,190.00	
Catalina deer permits	1,918.00	
Deer meat agents—locker permits	10,311.50	
Deer meat agents—wardens	1,196.00	
Waterfowl permits	4,028.00	
Elk permits	1,250.00	
Total 1949 series		3,381,668.73
1948 series		
Angling	$269.00	
Hunting	2,099.50	
Deer tags	11.00	
Deer meat agents—locker permits	11.00	
Total 1948 series		2,390.50
Total license revenue		$5,194,432.03

STATEMENT OF REVENUE—Continued

For the Period July 1, 1949, to June 30, 1950

One Hundred and First Fiscal Year

Revenue for fish and game preservation fund	Detail	Total
Other revenue		
Fish packers tax	$295,431.79	
Sardine packers tax	168,540.64	
Salmon packers tax	33,098.57	
Kelp tax	2,861.25	
Lease of kelp beds	1,934.90	
Miscellaneous	16,703.24	
Confiscated fish	8,336.22	
Court fines	60,724.56	
Interest on surplus money investment fund	94,569.83	
Total other revenue		$682,201.00
Total Fish and Game Preservation Fund		$5,876,633.03
Less: license commissions		250,519.81
Net Fish and Game Preservation Fund revenue		$5,626,113.22

STATEMENT OF EXPENDITURES
(as of June 30, 1950)

For the Period July 1, 1948, to June 30, 1949—One Hundredth Fiscal Year

	Salaries and wages	Operating expenses	Equipment	Less reimbursement for services to employees	Total major function
Administration	$67,851.81	$232,023.49	$5,072.96		$304,948.26
Patrol and law enforcement	776,005.06	375,879.09	76,221.23	—$20.00	1,228,085.38
Marine fisheries	251,193.16	126,946.99	30,848.80		408,988.95
Fish conservation	526,710.16	427,572.21	111,303.79	—13,813.78	1,051,772.38
Game conservation	486,854.45	232,184.32	96,587.71	—11,113.76	804,512.72
Licenses	44,006.31	39,787.51	225.45		84,019.27
Conservation education and public information	16,018.88	78,697.15	3,276.70		97,992.73
Pacific Marine Fisheries Commission					12,500.00
Special item (administration)					435.60
Unallocated (administration)					3.35
Retirement (administration)					209,136.30
Pittman-Robertson (retirement)					89,478.73
Total expenditures					$4,291,873.67

STATEMENT OF EXPENDITURES
(as of December 31, 1950)

For the Period July 1, 1949, to June 30, 1950—One Hundred and First Fiscal Year

	Salaries and wages	Operating expenses	Equipment	Total major function
Administration	$83,806.81	$290,071.84	$7,931.10	$381,809.75
Less reimbursement—rent and utilities				—25,425.92
Less reimbursement—use of auto and operating equipment				—58,037.43
Less reimbursement—subsistence				—2,984.49
Patrol and law enforcement	781,737.07	388,250.59	128,435.51	1,298,423.17
Marine fisheries	297,097.16	141,326.53	18,564.06	456,987.75
Fish conservation	580,122.02	347,090.58	59,639.90	986,852.50
Game conservation	533,933.70	297,058.53	157,977.19	988,969.42
Licenses	48,283.56	91,145.02	530.83	139,959.41
Conservation education and public information	23,105.24	52,104.57	4,980.29	80,190.10
Retirement (administration)				270,080.56
Board of Control claim				1,539.82
Pacific Marine Fisheries Commission				12,500.00
Total expenditures				$4,530,864.64

APPENDIX B

GAME STATISTICS

TABLE 1. GAME BIRD RELEASES

Liberation of Game Farm Birds, January 1, 1948, Through December 31, 1949

County	Ring-neck	Reeves	Turkey	Chukar	Valley quail	Total
Alameda	304					304
Amador	3,013					3,013
Butte	4,432	94				4,526
Calaveras	35					35
Colusa	9,791					9,791
Contra Costa	3,874					3,874
Del Norte	20					20
El Dorado		69				69
Fresno	11,899					11,899
Glenn	6,233				25	6,258
Humboldt	682					682
Imperial	9,880			193		10,073
Inyo	4,413					4,413
Kern	6,580			40	451	7,071
Kings	1,624				60	1,684
Lake	349					349
Lassen	2,640					2,640
Los Angeles	1,123			20	429	1,572
Madera	1,429					1,429
Marin	690				64	754
Mendocino	1,269					1,269
Merced	10,183					10,183
Modoc	6,835					6,835
Mono	629					629
Monterey	290		64			354
Napa	1,923				182	2,105
Orange	470				115	585
Placer	1,703					1,703
Plumas	16					16
Riverside	5,790			210	423	6,423
Sacramento	3,587					3,587
San Benito	277		35			312
San Bernardino	7,278	3		682	345	8,308
San Diego	1,811			1,087	50	2,948
San Joaquin	10,114					10,114
San Luis Obispo	149		7			156
Santa Barbara	1,372					1,372
Santa Clara	1,033					1,033
Santa Cruz	111					111
Shasta	1,587					1,587
Sierra	1,116				100	1,216
Siskiyou	4,007					4,007
Solano	5,480					5,480
Sonoma	224					224
Stanislaus	6,474				532	7,006
Sutter	7,715					7,715
Tehama	3,467					3,467
Tulare	9,323					9,323
Tuolumne	240					240
Ventura	2,000			20		2,020
Yolo	3,506					3,506
Yuba	3,227					3,227
Totals	172,217	166	106	2,252	2,776	177,517

TABLE 2. PREDATORY ANIMAL CATCH BY COUNTIES

	July 1—December 31, 1948				January 1—December 31, 1949				Total for period
	Coyote	Bobcat	Other predators	Total	Coyote	Bobcat	Other predators	Total	
Alpine	26	5	4	35	5	5	11	21	56
Amador	21	7	38	66	45	17	106	168	234
Butte	53	7	77	137	94	4	193	291	428
El Dorado					55	13	79	147	147
Fresno	110	41	109	260	105	81	523	709	969
Humboldt	21	55	47	123	32	162	87	281	404
Imperial					8	3	35	46	46
Inyo	50		8	58	129	10	61	200	258
Kern					138	6	10	154	154
Kings					12		7	19	19
Lake	17	12		29	36	23	1	60	89
Lassen	344	35	107	486	410	74	178	662	1,148
Los Angeles	89	46	174	309	97	50	141	288	597
Madera	31	7	9	47	32	17	39	88	135
Mariposa	42	4	4	50	38	17	9	64	114
Merced	1		3	4	1	1		2	6
Modoc	80	2		82	20	9	17	46	128
Mono	17		2	19	28	4	16	48	67
Monterey		3		3	53	176	587	816	819
Nevada	21	6	11	38	50	4	113	167	205
Placer	32	1	7	40	39	8	34	81	121
Plumas	228	68	2	298	285	92	3	380	678
Riverside	36	24	32	92	136	106	109	351	443
San Benito	14	45	122	181	27	184	640	851	1,032
San Bernardino	103	56	99	258	196	86	192	474	732
San Diego	80	35	31	146	155	75	146	376	522
San Luis Obispo	40	51	300	391	23	26	134	183	574
Santa Barbara	33	6	21	60	127	32	35	194	254
Santa Clara	5	3	5	13	5	3	3	11	24
Shasta	47	8	19	74	150	33	93	276	350
Sierra					21	3	17	41	41
Siskiyou	96	11	6	113	95	9	36	140	253
Stanislaus	1	1	1	3	40	12	32	84	87

Sutter				2			22	22	22
Tehama	2				53	11	12	76	78
Trinity					20	8	9	37	37
Tulare	147	47	85	279	156	43	149	348	627
Tuolumne	85	22	3	110	165	27	38	230	340
Ventura	102	14	6	122	124	25	26	175	297
Yuba			2	2	14		13	27	29
	1,974	622	1,334	3,930	3,219	1,459	3,956	8,634	12,564

	July 1—December 31, 1948	January 1—December 31, 1949
Average number of trappers	29	35
Miles of trapline	237,773	500,706
Number of sets	250,061	512,714
Number of days	4,430	10,807

1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	Totals
			1			1			2	4	5	1	20
													3
										1			27
1		4	1		3	3			2		1	2	71
2	1	1	3	1					1				63
1		1	2						1	3	3	1	83
											1		1
6	11	7	8	5	1		1	1	2	1		8	224
8		2	6	3	6	1	2	1	7		1	5	229
3	6	16	2	7	19	3	2	2	12	6	7	1	189
9	11	7	5	7	6	12	11	7	3	12	5	11	262
24	25	28	16	22	7	5	19	11	18	24	6	17	1,080
													2
		1	3							1			23
5	12	5	2	10	5	13	5	9	10	6	11	14	141
													1
12	15	19	8	12	9	7	7	3	6	7	5	11	502
								1					13
8	7	6	5	3	2			1	5	7	1		191
2		3	4	12	1	9		2		1			102
			1										3
	1	1							4	1	2	1	146
12	16	21	11	31	20	8	20	6	15	7	18	12	691
											2		7
								1					6
										3	2	1	24
17	11	19	14	16	10	6	17	14	13	18	29	34	646
	1												4
1	1	5		1			1		1			1	35
			5										18
	7	4	2									1	117
			1										19
2	3		3	2		5	5	1	5	1	1	1	115
													1
	1						1	3		1			65
4	4	15	8	6	2	2	1	7	5	4	3	1	172
14	4	11	10	6	6	2		2	9	8	10	8	275
													0
													2
2	4	5	4	5	2	7	3	4	5	1	9	6	216
													1
5	11	11	18	5	6		4	6	9	1		4	438
2	5	1	4	1		9	4	3	4	2	7	11	141
													4
18	8	11	8	7	5	18	9	4	10	22	15	12	699
				2	3	1		2	1	1			43
18	18	22	12	31	13	1	4	3	10	5	17	6	540
													0
							1				1		32
	3												25
													2
6	10	9	3	4	6	2	17	11	15	11	2	6	138
29	28	50	38	24	19	23	13	15	26	22	16	18	933
8	15	13	17	12	8	6	17	21	18	14	15	8	505
3	1		1	6			3	2					185
1	9		2	2		1					1		165
							2						3
1	2				3	2	5						15
224	253	292	228	243	162	150	177	143	219	195	199	202	10,324

APPENDIX C
MARINE FISHERIES STATISTICS

TABLE 1. CALIFORNIA FISHERIES PRODUCTION

	1948	1949	Total
Total landings, pounds	899,775,000	1,135,346,000	2,035,121,000
Cases of fish canned	12,274,848	13,161,076	25,435,924
Tons of fish meal produced	44,450	66,504	110,954
Gallons of fish oil produced	2,833,197	6,591,234	9,424,431
Gallons of liver oil produced	140,009	134,021	274,030

TABLE 2. POUNDS AND VALUE[1] OF COMMERCIAL FISH LANDINGS IN CALIFORNIA

Species	1948		1949	
	Pounds	Value	Pounds	Value
Yellowfin tuna	191,724,000	$32,437,000	185,612,000	$30,295,000
Skipjack	58,772,000	9,329,000	78,575,000	11,655,000
Sardine	362,037,000	10,732,000	633,475,000	10,757,000
Albacore	37,623,000	11,019,000	44,279,000	8,192,000
Salmon	7,769,000	2,009,000	6,848,000	1,678,000
Crab	11,890,000	1,261,000	11,117,000	1,294,000
Pacific mackerel	39,386,000	1,381,000	49,771,000	1,286,000
Jack mackerel	72,898,000	2,136,000	51,250,000	1,111,000
Sole	21,655,000	1,139,000	19,693,000	918,000
Shark	2,481,000	1,051,000	1,552,000	833,000
Bluefin tuna	6,697,000	1,125,000	4,389,000	713,000
Yellowtail	10,446,000	1,163,000	7,319,000	686,000
Spiny lobster	1,518,000	549,000	1,780,000	686,000
Abalone	3,229,000	371,000	3,568,000	398,000
Barracuda	2,126,000	330,000	2,474,000	368,000
Rockfish	6,541,000	396,000	6,044,000	340,000
White sea bass	1,114,000	268,000	1,412,000	291,000
California halibut	1,307,000	269,000	1,263,000	238,000
Squid	19,256,000	518,000	6,859,000	184,000
Bonito	9,135,000	1,062,000	1,835,000	179,000
Sablefish	2,068,000	175,000	1,769,000	135,000
Lingcod	2,059,000	173,000	1,654,000	125,000
Shad	426,000	27,000	1,336,000	107,000
Broadbill swordfish	1,114,000	355,000	198,000	88,000
Anchovy	10,836,000	348,000	3,322,000	56,000
All other	15,668,000	890,000	7,952,000	635,000
Totals	899,775,000	$80,513,000	1,135,346,000	$73,248,000

[1] Value to the fishermen.

TABLE 3. YEARLY LANDINGS IN POUNDS—COMMERCIAL FISH

Exclusive of Mollusks and Crustaceans[1]

Year	Pounds	Year	Pounds
1916	88,390,465	1933	811,002,474
1917	202,987,474	1934	1,378,154,189
1918	254,238,270	1935	1,433,616,046
1919	256,120,774	1936	1,753,632,108
1920	215,431,810	1937	1,354,050,220
1921	129,086,209	1938	1,298,036,943
1922	176,216,485	1939	1,472,988,721
1923	246,383,030	1940	1,284,881,633
1924	325,948,382	1941	1,517,533,106
1925	425,695,707	1942	1,166,614,194
1926	382,602,891	1943	1,215,161,305
1927	471,210,260	1944	1,430,202,850
1928	572,070,120	1945	1,138,943,309
1929	841,149,549	1946	855,997,768
1930	680,858,788	1947	763,324,829
1931	491,083,110	1948	862,258,458
1932	542,060,362	1949	1,110,151,411

[1] Includes sardine deliveries to reduction ships and tuna importations.

TABLE 4. COMMERCIAL FISHING FLEET

Home port	1948-1949	1949-1950
Eureka	546	581
Sacramento	394	369
San Francisco	750	800
Monterey	406	434
Santa Barbara	244	244
Los Angeles	2,230	2,362
San Diego	845	946
Alaska, Oregon, Washington	307	424
Totals	5,722	6,160

TABLE 5. NATIONALITY OF LICENSED COMMERCIAL FISHERMEN

Nativity	1948-1949	1949-1950
United States	10,152	10,734
Italy	1,386	1,401
Jugoslavia	772	690
Norway	446	523
Portugal	414	468
Great Britain	204	194
Japan	143	170
Sweden	98	99
Mexico	87	91
Finland	51	70
Spain	52	57
Germany	59	56
Greece	55	53
Denmark	59	51
Costa Rica	37	35
Philippine Islands	30	33
Russia	31	32
All others	185	205
Totals	14,261	14,962

TABLE 6. RESIDENCE OF LICENSED COMMERCIAL FISHERMEN

Region of residence	1948-1949	1949-1950
Eureka	929	917
Sacramento	665	619
San Francisco	1,292	1,325
Monterey	1,267	1,319
Santa Barbara	622	594
Los Angeles	5,832	5,961
San Diego	2,914	3,273
Alaska, Oregon, Washington	716	918
Mexico	24	36
Totals	14,261	14,962

APPENDIX D

FISH DISTRIBUTION AND RESCUE

TABLE 1. FISH PLANTED—1948

Hatchery Reared Fish Planted in Each County

	Trout					Salmon		Total number of fish
	Rainbow	Steelhead	Cutthroat	Eastern Brook	Brown	King	Kokanee	
Alpine	139,304		139,120	122,264				400,688
Amador	93,000			2,000				95,000
Butte	337,400			15,000				352,400
Calaveras	156,126							156,126
Del Norte	40,530	25,600		2,310				68,440
Eldorado	1,045,132			397,500				1,442,632
Fresno	860,490			215,434				1,075,924
Glenn	15,000							15,000
Humboldt	101,865	33,768		9,510				145,143
Inyo	479,086			182,970	26,540			688,596
Kern	120,104							120,104
Lassen	249,100			109,700	9,500			368,300
Los Angeles	143,330							143,330
Madera	342,127			163,081				505,208
Marin	9,080							9,080
Mariposa	627,415			112,300	68,793			808,508
Mendocino	49,943							49,943
Modoc	73,200							73,200
Mono	718,505		147,345	425,582	257,420			1,548,852
Monterey	56,627							56,627
Napa	37,635							37,635
Nevada	586,311			316,742			22,400	925,453
Orange	6,100							6,100
Placer	581,757			149,290				731,047
Plumas	910,302			74,369	36,000			1,020,671
Riverside	25,140							25,140
San Bernardino	368,491							368,491

San Diego	36,240							36,240
San Francisco	16,023							16,023
San Luis Obispo	16,100							16,100
San Mateo	16,910							16,910
Santa Barbara	2,400							2,400
Santa Clara	39,401							39,401
Santa Cruz	54,084							54,084
Shasta	565,413			36,600	71,400			673,413
Sierra	605,520			97,270				702,790
Siskiyou	391,559			171,850		755,908		1,319,317
Tehama	196,400			34,500	59,200			290,100
Trinity	246,484			87,368				333,852
Tulare	801,708			97,550				899,258
Tuolumne	546,671			184,340	58,220		22,750	811,981
Ventura	85,420							85,420
Yuba	50,960							50,960
Grand totals	11,844,393	59,368	286,465	3,007,530	587,073	755,908	45,150	16,585,887

TABLE 2. HATCHERY REARED WARM-WATER FISHES—1948

	Number of fish
Smallmouth black bass	24,432
Largemouth black bass	399
Sacramento perch	5,006
Bluegill	13,781
Total	43,618

TABLE 3. FISH RESCUED—1948

Trout	
Rainbow	1,880
Eastern brook	500
Steelhead	272,271
Brown	561
Cutthroat	51
Total	275,263
Salmon	
King	16,290
Silver	53,914
Total	70,204
State-county cooperative trout rescued	
Steelhead	84,300
Salmon	24,450
Total	108,750
Warm-water fishes	
Smallmouth black bass	34,300
Largemouth black bass	48,273
Striped bass	2,157
Sacramento perch	6,021
Crappie	15,343
Brown bullhead	298,907
White catfish	2,509
Bluegill	51,652
Green sunfish	792
Warmouth	35
Total	459,989

TABLE 4. FISH PLANTED—1949

Hatchery Reared Fish Planted in Each County

County	Trout					Salmon		Total number of fish
	Rainbow	Steelhead	Cutthroat	Eastern brook	Brown	King	Kokanee	
Alpine	142,254		132,483	130,080				404,817
Amador	197,515			25,000				222,515
Butte	261,049			15,000				276,049
Calaveras	174,804			8,000				182,804
Colusa	6,800							6,800
Del Norte	5,000	399,500						404,500
Eldorado	829,004			464,500			90,020	1,383,524
Fresno	925,576			171,681				1,097,257
Glenn	21,800							21,800
Humboldt	77,864	312,799				155,400		546,063
Inyo	483,268			117,612	132,150			733,030
Kern	98,441							98,441
Lake	15,799							15,799
Lassen	252,560			53,600	15,950			322,110
Los Angeles	104,445							104,445
Madera	362,761			108,046				470,807
Marin	75,240							75,240
Mariposa	538,302			35,550				573,852
Mendocino	8,079					140,720		148,799
Modoc	182,463							182,463
Mono	573,889		190,800	429,054	432,861			1,626,604
Monterey	35,624							35,624
Napa	95,694	9,388						105,082
Nevada	669,717			289,062			79,980	1,038,759
Orange	7,000							7,000
Placer	614,440			104,542			20,000	738,982
Plumas	928,237			106,733				1,034,970
Riverside	61,925							61,925
San Bernardino	273,547							273,547
San Diego	24,800							24,800
San Luis Obispo	11,590							11,590

TABLE 4. FISH PLANTED—1949—Continued

Hatchery Reared Fish Planted in Each County

County	Trout					Salmon		Total number of fish
	Rainbow	Steelhead	Cutthroat	Eastern brook	Brown	King	Kokanee	
San Mateo	8,578							8,578
Santa Barbara	5,595							5,595
Santa Clara	6,000							6,000
Santa Cruz	24,541	23,935						48,476
Shasta	476,851			32,795	75,000			584,646
Sierra	467,876			123,308				591,184
Siskiyou	416,830			145,186				562,016
Solano	9,802							9,802
Tehama	220,800			19,400	10,000			250,200
Trinity	344,917	15,200		56,595				416,712
Tulare	941,564			114,450				1,056,014
Tuolumne	636,112			214,750			6,460	857,322
Ventura	35,105							35,105
Yuba	45,560							45,560
Grand totals	11,699,618	760,822	323,283	2,764,944	665,961	296,120	196,460	16,707,208

TABLE 5. HATCHERY REARED WARM-WATER FISHES—1949

	Number of fish
Smallmouth black bass	851
Largemouth black bass	77,936
Sacramento perch	175
Bluegill	11,095
Total	90,057

TABLE 6. FISH RESCUED—1949

Trout	
Rainbow	2,176
Steelhead	486,584
Brown	1,250
Cutthroat	2
Golden	380
Total	490,392
Salmon	
King	17,409
Silver	107,733
Total	125,142
State-county cooperative trout rescued	
Steelhead	115,705
Salmon	54,787
Total	170,492
Warm-water fishes	
Smallmouth black bass	13,062
Largemouth black bass	289,720
Sacramento perch	175
Crappie	31,292
Brown bullhead	62,669
White catfish	6,826
Bluegill	638,228
Green sunfish	7,649
Warmouth	81
Carp	211
Blackfish	227
Fresh-water sculpin	2
Total	1,050,142

TABLE 7. FISH PLANTED

Hatchery Reared Fish Planted in Each County

January 1 to June 30, 1950 (inclusive)

County	Trout				Salmon		Total number of fish
	Rainbow	Steelhead	Eastern brook	Brown	King	Kokanee	
Alpine	2,760		15,000				17,760
Amador	80,525						80,525
Butte	229,146		15,000				244,146
Calaveras	8,108						8,108
Eldorado	20		15,000			142,260	157,280
Fresno	614,631		78,440				693,071
Glenn	3,000						3,000
Inyo	195,828						195,828
Kern	15,542						15,542
Lassen	119,941						119,941
Los Angeles	80,640						80,640
Madera	4,545						4,545
Marin	31,299						31,299
Mariposa	15,463						15,463
Mendocino	3,875	10,400			136,140		150,415
Merced	720						720
Modoc	32,855						32,855
Mono	174,802		138,143	410,872			723,817
Monterey	51,395						51,395
Napa	47,452						47,452
Nevada						100,000	100,000
Orange	7,250						7,250
Placer						471,215	471,215
Plumas	357,807						357,807
Riverside	23,890						23,890
San Bernardino	112,790						112,790
San Diego	15,000						15,000

San Francisco	75,609						75,609
San Luis Obispo	21,090						21,090
San Mateo	9,014						9,014
Santa Barbara	14,660						14,660
Santa Clara	33,361						33,361
Santa Cruz	35,098	10,440					45,538
Shasta	189,051		5,525				194,576
Siskiyou	238,002		102,121				340,123
Tehama	76,011		3,000				79,011
Trinity	81,040		65,615				146,655
Tulare	394,897		142,047				536,944
Tuolumne	1,000					26,000	27,000
Ventura	34,485						34,485
Yuba	10,000						10,000
Grand totals	3,442,602	20,840	579,891	410,872	136,140	739,475	5,329,820

TABLE 8. HATCHERY REARED WARM-WATER FISHES

January 1 to June 30, 1950 (inclusive)

	Number of fish
Largemouth black bass	4,981
Bluegill	195
Total	5,176

TABLE 9. FISH RESCUED

January 1 to June 30, 1950 (inclusive)

Trout		Warm-water fishes	
Rainbow	2,080	Smallmouth black bass	7,916
Steelhead	242,741	Largemouth black bass	15,932
Cutthroat	60	Black bass	1,338
Brown	1,336	Brown bullhead	166,693
		White catfish	668
Total	246,217	Bluegill	41,635
		Green sunfish	4,060
Salmon		Crappie	18,913
King	1,365	Golden shiners	7,504
Silver	36,794	Blackfish	97
Total	38,159	Total	264,756

APPENDIX E

ARRESTS, FINES AND SEIZURES

TABLE 1. TOTAL ARRESTS FOR PERIOD OF 48 YEARS

1902-1904	550	1926-1928	4,390
1904-1906	774	1928-1930	5,388
1906-1908	1,192	1930-1932	5,237
1908-1910	1,771	1932-1934	3,795
1910-1912	2,063	1934-1936	4,535
1912-1914	1,993	1936-1938	6,382
1914-1916	2,087	1938-1940	7,444
1916-1918	1,797	1940-1942	7,262
1918-1920	1,891	1942-1944	4,298
1920-1922	2,258	1944-1946	5,902
1922-1924	2,715	1946-1948	11,331
1924-1926	3,207	1948-1950	12,947

TABLE 2. ARRESTS AND CONVICTIONS—RECAPITULATION

	Number of arrests	Fines	Jail sentences (days)
Fish cases			
1948-1949	3,674	$161,879.13	512½
Game cases			
1948-1949	3,040	$169,779.00	1,798½
Totals for 1948-1949	6,714	$331,658.13	2,311
Fish cases			
1949-1950	3,728	$97,601.72	753½
Game cases			
1949-1950	2,505	$132,645.20	5,134
Totals for 1949-1950	6,233	$230,246.92	5,887½
Recapitulation:			
1948-1949	6,714	$331,658.13	2,311
1949-1950	6,233	230,246.92	5,887½
Totals	12,947	$561,905.05	8,198½

TABLE 3. SEIZURES OF FISH AND GAME

Fish	July 1, 1948 to June 30, 1949	July 1, 1949 to June 30, 1950	Total
Abalone	3,839	6,691	10,530
Abalone, pounds	2		2
Barracuda	73	14	87
Barracuda, pounds		207	207
Rock bass	71	168	239
Sand bass		25	25
Striped bass	1,840	1,362	3,202
Black bass	53	11	64
White sea bass, pounds	250	1,400	1,650
Bass, pounds	21	97	118
Carp	39	7	46
Catfish	493	303	796
Catfish, pounds	521	116	637
Clams	8,909	15,775	24,684
Clams, pounds		31	31
Cockles	22,615	23,522	46,137
Corbina	1		1
Crabs	72	179	251
Crabs, pounds		244	244
Crappie	101	88	189
Crappie, pounds	8		8
Frogs	158	42	200
Halibut	8		8
Halibut, pounds	110		110
Lobsters	546	1,374	1,920
Lobsters, pounds	5,023	682	5,705
Pacific mackerel, pounds		1,675	1,675
Mullet	5		5
Octopus	1	31	32
Octopus, pounds		16	16
Perch	9		9
Rockfish	64		64
Salmon	139	82	221
Salmon, pounds		421	421
Sardines		28	28
Sardines, pounds	850,193	153,504	1,003,701
Sardines, tons	697½		697½
Scallops	128		128
Sea urchins		3	3
Shad	5		5
Skipjack, pounds	3,747	7,198	10,945
Steelhead	9		9
Sturgeon	1	3	4
Sturgeon, pounds		6	6
Trout	2,582	2,589	5,171
Trout, pounds	195	4	199
Yellowtail, pounds	3,142	82,260	85,402
Yellowfin, pounds	8,298		8,298
Yellowfin croaker		72	72

TABLE 3. SEIZURES OF FISH AND GAME—Continued

Game	July 1, 1948 to June 30, 1949	July 1, 1949 to June 30, 1950	Total
Antelope		5	5
Bear	1	1	2
Bear meat, pounds	60	20	80
Beaver		1	1
Coots	112		112
Deer	279	299	578
Deer meat, pounds	2,476	2,319	4,795
Doves	1,406	1,283	2,689
Ducks	2,639	1,094	3,733
Elk	1	2	3
Elk meat, jars	26		26
Elk meat, pounds	400	74	474
Geese	129	199	328
Grebe	13		13
Grouse	4	2	6
Migratory waterfowl		32	32
Moose meat, pounds		30	30
Muskrats	11		11
Non-game	79	22	101
Pheasants	347	269	616
Pigeons	117	17	134
Pine marten	1		1
Quail	105	122	227
Rabbits	106	184	290
Sagehen	2	2	4
Shorebirds	23	40	63
Squirrels	16	24	40
Swans	33		33
Skins, beaver	4		4
Skins, mink	4		4
Skins, muskrat	38		38
Skins, sea otter	2		2

TABLE 4. FISH CASES

Offense	July 1, 1948 to June 30, 1949			July 1, 1949 to June 30, 1950		
	Number of arrests	Fines imposed	Jail sentences (days)	Number of arrests	Fines imposed	Jail sentences (days)
Abalone: Undersize; overlimit; without permit; out of shell; closed season; no license; failure to show license on demand; using diving apparatus in Dist. 19A; taking in marine life refuge; failure to keep accurate books; failure to deliver tickets; using another's license	375	$10,290.00	38	523	$13,655.00	127½
Angling: No license; late angling; failure to show license; possession of gaff; using artificial light; night fishing; using another's license; transferring license; illegal spearing; more than one line; fishing within 150 ft. of dam; closed waters; taking by use of firearms; more than 2 attractor blades; false statement in obtaining license; game fish for bait; set lines; closed waters; using dip net; gill net; blocking stream; illegal seining; backdating license; chumming; trespassing to fish; using salmon eggs; chumming in inland waters	1,468	24,564.00	64½	1,242	19,109.50	86½
Albacore: Sale of undersized				2	175.00	
Bass, Black: No license; closed season; using set lines; more than 1 pole; selling; possession of undersize	6	185.00	50	10	655.00	
Bass, Kelp: No license				1	25.00	
Bass, Rock: Taking overlimit; no license; using another's license	4	125.00		8	230.00	
Bass, Striped: Overlimit; undersize; set line; failure to show on demand; night fishing; offering prizes; taking with 2 rods; on commercial boat; sale; resisting arrest; borrowed license; mutilated fish and game plates	398	12,682.20	200	365	9,519.50	5
Bass, White Sea: Possession on purse seiner; undersize; sale of undersize	1	25.00		3	100.00	
Barracuda: Taking undersize; overlimit; selling from sport boat	3	50.00		2	35.00	
Carp: Closed season; fyke nets; night fishing; no license; no wholesale license	2	300.00		3	135.00	
Catfish: Overlimit; operating fish trap; undersize; taking with fyke nets; taking without license; taking at night; other than by angling; in District 22; with more than 1 line; sale of undersize; taking with spear; failure to give receipt	46	2,208.00		63	2,210.00	50
Clams, Big Neck: Overlimit; no license				26	650.00	
Clams, Cockle: Overlimit; undersize; no license; taking in closed season; using another's license; failure to show license on demand	79	1,610.00		92	1,885.00	18
Clams, Gaper: Overlimit; no license				7	125.00	
Clams, Pismo: Overlimit; undersize; out of shell; taking at night; no license; possession of forks and shovels in refuge; possession for commercial use; possession undersize in refuge; failure to return undersize to water; taking in refuge	482	12,250.50	115	448	11,887.00	250
Clams, Razor: Overlimit				1	25.00	
Commercial: no license; failure to deliver reports; illegal gill net; using drag net in less than 25 fathoms; fish wastage; closed area; round haul net District 20; undersize fish; trawl nets in closed district; no dealer license; no boat registration; failure to issue receipts; no party boat license; resisting arrest; undersize sardines; no alien license; boat improperly numbered; failure to deliver production reports	259	9,215.00	45	343	9,107.50	
Crabs: Undersize; taking females; failure to show on demand; possession of over 500 lbs. on drag boat; closed season	7	155.00		18	675.00	
Corbina: Spearing				1	10.00	

TABLE 4. FISH CASES—Continued

Offense	July 1, 1948 to June 30, 1949			July 1, 1949 to June 30, 1950		
	Number of arrests	Fines imposed	Jail sentences (days)	Number of arrests	Fines imposed	Jail sentences (days)
Crappie: Overlimit; possession closed season; taking closed season; taking at night; no license	5	$95.00		13	$380.00	
Frogs: Undersize; taking closed season; possession of spears within 300 ft. of prohibited stream	35	875.00		16	480.00	
Halibut: Failure to show license				1	suspended	
Lobsters: Closed season; oversize; undersize; operating traps in closed district; baiting traps with abalone; failure to show on demand; wilfully disturbing another's traps; use of traps in District 21; possession and sale of undersize	50	2,815.00		58	3,445.00	39
Mullet: Illegal nets	3	250.00				
Mussels: No license				3	25.00	
Octopus: No license	1	25.00		1	25.00	
Perch: No license				1	10.00	
Pike: No license				1	10.00	
Pollution: Oil; sawdust; bilge; fish refuse; copper sulphate; bluestone; black leaf 40; clorax; cloroform	49	5,520.00		45	4,065.00	
Rockfish: No license				1	10.00	
Salmon: Illegally taken; snagging; overlimit; shooting; taking from spawning area; spearing; gaffing; closed season; at night; mutilation; taking within 250 ft. of fishway; taking without license; using fyke nets; using borrowed license; taking from closed stream; possession untagged; possession gill netted	76	3,085.00		72	2,225.00	100
Sardines: Taking undersize; using illegal net in Dist. 16; no commercial license; taking for use by packer in closed season; using purse seiner in Dist. 20; canning sardines taken for bait	39	1,420.00		29	1,575.00	
Scallops: Overlimit	1	10.00				
Sea Urchins: Taking from Pt. Lobos State Park				2	20.00	
Shad: No license	4	40.00		2	20.00	
Shark: No license				3	suspended	
Skipjack: Undersize	1	150.00				
Steelhead: Closed season; taking other than by angling	5	320.00				
Sturgeon: Possession; taken in gill net; possession of roe	1	12.00		5	275.00	
Sunfish, Bluegill: Overlimit; taking other than by angling; closed season; taken too close to dam	30	820.00		40	1,025.00	27½
Trout: Using 2 rods; set lines; closed area; taking by hand; overlimit; using 3 attractor blades; closed season; no license; snagging; chumming; taking at night; taking in District 103.6; possession gaff within 300 ft. of stream; using artificial light	242	9,656.00		258	7,745.00	50
Tuna, Yellowfin: Sale of undersize	2	300.00		16	890.00	
Yellowtail: Undersize and offering for sale; taking overlimit; purchase of undersize and selling undersize				3	80.00	
Totals	3,674	$99,052.70	512½	3,728	$97,601.72	753½
Court forfeitures (Sales of fish)		62,826.43				
Grand Total		$161,879.13				

TABLE 5. GAME CASES

Offense	July 1, 1948 to June 30, 1949			July 1, 1949 to June 30, 1950		
	Number of arrests	Fines imposed	Jail sentences (days)	Number of arrests	Fines imposed	Jail sentences (days)
Antelope: Possession closed season; taking female; using borrowed license; illegal possession	1	$350.00		7	$850.00	425
Bear: Closed season; taking with trap	3	100.00		5	275.00	
Bear Meat: Possession closed season	1	20.00				
Beaver and Mink Hides: Hides and illegal possession	1			3	400.00	
Commercial: No breeder's license				1	25.00	
Coots: Closed season; overlimit	12	325.00	3			
Deer: Failure to tag; closed season; doe; spike buck; forked horn; spotted fawn; defacing tag; overlimit; in refuge; night hunting; "A" tag in No. 1 deer district; tag not validated; using another's tag; spotlighting; no tag; failure to retain antlers; transport without permit; tagging another's deer; taking in refuge; allowing dogs to run; using .22; full metal jacketed bullets; removing sex evidence; taking deer with Utah license (Calif. resident); overlimit does; failure to show deer on demand; taking another's deer; possession of guns and deer in refuge; Calif. resident possessing deer on Montana license; no valid hunting license	520	45,166.00	713	510	46,066.00	2,950
Deer Meat: Unstamped; closed season; doe; possession illegally taken; possession more than 15 days after closed season; Calif. resident possession deer meat on Colorado resident license; no transport permit; no evidence of sex; possessing deer meat and gun in refuge 4F; failure to show meat on demand; possessing parts of doe; purchase of deer meat	115	10,610.00	410	120	11,791.00	1,071
Doves: Late shooting; .22 rifle; from auto; overlimit; closed season; late shooting; illegal import; poisoning; unplugged gun; possessing nest and eggs; no license; using air pistol	159	5,668.00		145	5,555.00	37
Ducks: Closed season; purchase; overlimit; taking in refuge; unplugged gun; no stamp; poisoning; failure to show; offer for sale; illegal import; late shooting; shooting from motorboat; driving with airplane; illegal license; failure to declare; Calif. resident using Utah license; using borrowed license; shooting from car; bringing illegal ducks into Calif.; making false statement on license; using live decoys; possession wooden duck in closed area; shooting at ducks with .22 rifle in game refuge	574	31,365.00	50	374	15,937.50	
Elk: Possession of meat; possession of elk; Calif. resident possessing meat with Idaho resident license; overlimit; taking of cow with bull permit; no evidence of sex; possession by Calif. resident on Wyoming license; no transport permit	6	625.00	365	3	450.00	
Geese: Closed season; late shooting; overlimit; shooting from motorboat; unplugged gun; using .22 rifle; no stamp; possessing gun and geese on refuge; stealing game; night hunting; possession of cackling goose; on closed area; hunting without valid license	36	1,540.00		94	3,137.50	
Grebe: Possession	1	50.00				
Grouse: Possession closed season	7	425.00		1	35.00	

TABLE 5. GAME CASES—Continued

Offense	July 1, 1948 to June 30, 1949			July 1, 1949 to June 30, 1950		
	Number of arrests	Fines imposed	Jail sentences (days)	Number of arrests	Fines imposed	Jail sentences (days)
Hunting: In refuge; late and early shooting; from auto; at night; with .22; no license; from highway; metal jacketed bullets; power boat; spotlighting; unplugged gun; hunting on posted land; trespassing on Game Management Area; hunting in closed zone in cooperative hunting area; illegal importation of game; failure to show license on demand; possessing arm band off cooperative area; making false statement on license; failure to return arm bands; non-resident using resident license; permit hunting on Game Management Area without dog in group; transferring license and tags	1,033	$40,516.00	33½	546	$18,382.70	366
Migratory Waterfowl: From motor boat; closed season; taking fully protected bird; using .22; late shooting; no license; early shooting				110	3,375.00	
Moose: Calif. resident possessing meat on Montana resident license				1	100.00	
Mudhens: Closed season	1	50.00				
Muskrat: Closed season	1	10.00				
Non-Game Birds: Killing; possession, no license; making false statement to get license	30	822.00		14	621.00	
Pheasants: Closed season; hen; from auto; trapping; spotlighting; failure to tag; illegal importation; no evidence of sex; no license; overlimit; unplugged gun; taking in cooperative area without permit; trespassing on cooperative hunting area; taking cock pheasant on refuge; using .22 rifle; failure to show on demand; transferred tag; shooting from public highway; overlimit	278	21,384.00	164	295	15,572.50	275
Pigeons: Trapping; closed season; taking with rifle	41	1,720.00		6	305.00	
Pine Marten: Closed season	1	100.00				
Quail: Closed season; from auto; with rifle; trapping; using .22 rifle; holding valley quail without permit; trespassing on restricted cooperative area; taking in game refuge; taking with illegal gun; failure to declare birds taken in Mexico; overlimit	49	2,550.00		53	2,700.00	10
Rabbits: Closed season; night hunting; in refuge; unplugged gun; snaring; no license; spotlighting; early shooting; shooting from car; possessing and transporting illegal game into Calif.	102	2,901.00	50	186	5,697.00	
Sagehen: Possession	2	185.00		4	635.00	
Sea Otter: Possession of skins	1	100.00				
Shorebirds: Possession; killing; possessing curlew; taking snipe, plover, avocet, loon	18	409.00	10	8	225.00	
Squirrels: Killing gray squirrel; possession in closed season; possession tree squirrel; no license; illegal possession	16	870.00		19	510.00	
Swan: Possession	31	1,918.00				
Totals	3,040	$169,779.00	1,798	2,505	$132,645.20	5,134

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